INDEXED.

International Marine Engineering

SEPTEMBER, 1910.

A NEW DEPARTURE IN AMERICAN SHIPBUILDING.

On Aug. 6 there was delivered to the owners the steel freight steamship *Ruth,* constructed on the Isherwood system, and built at the yards of the Newport News Shipbuilding & Dry Dock Company, at Newport News, Va., to the order of the A. H. Bull Steamship Company, of New York.

This is the second vessel built at the Newport News shipyard for that firm of ship owners, the steamship *Jean* having been completed just a year previous. The *Jean* has been engaged in carrying phosphate rock from Florida to Northern ports, with return cargoes of coal. The *Ruth* has entered the same trade. These two vessels are practically identical in size and general arrangement, but in order to utilize to best advantage the limited draft of water available at the Southern ports, it was decided to build the second vessel on the Isherwood system of longitudinal framing.

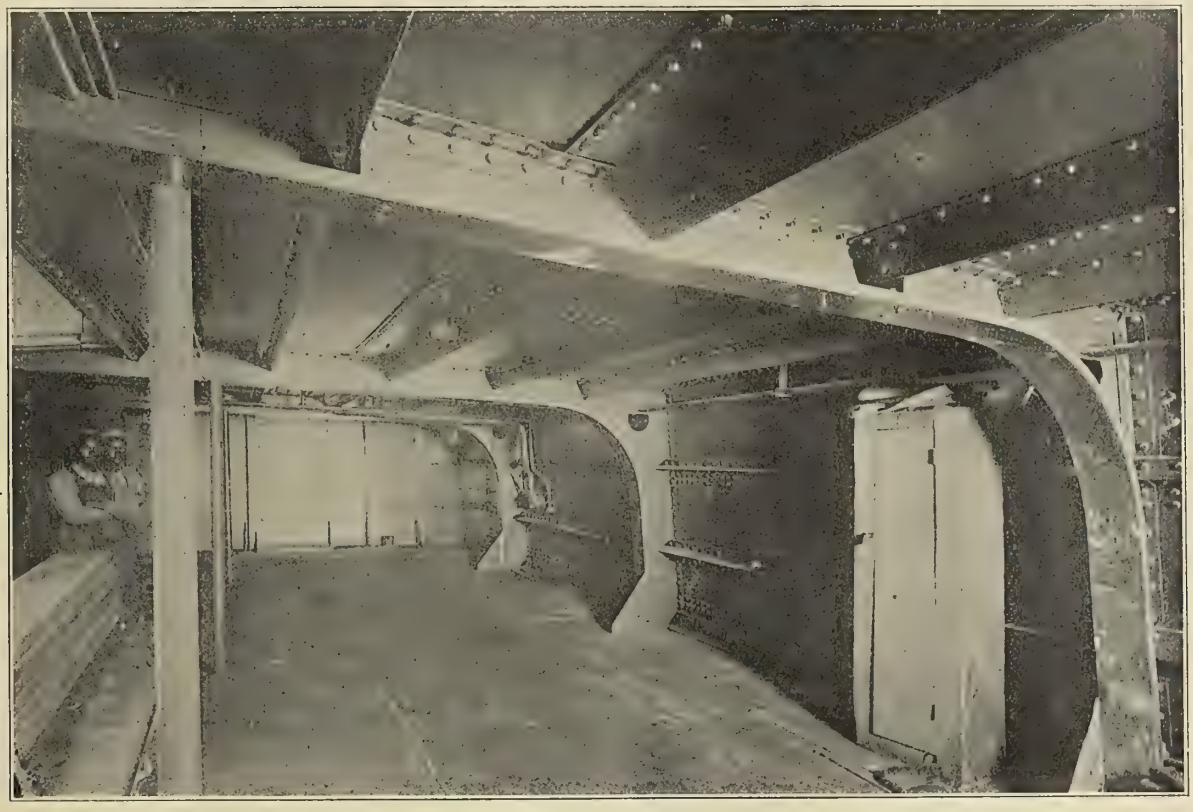


FIG. 1.—CONSTRUCTION OF BRIDGE ENCLOSURE ON THE LONGITUDINALLY FRAMED FREIGHT STEAMSHIP RUTH.

The Isherwood system of framing has been in use for several years in Great Britain, and the number of vessels being built on this system there and on the Continent is increasing rapidly, as its advantages become more generally known. The *Ruth* is the second vessel built in the United States on the Isherwood system, the *Millinocket,* owned by the same firm, having been completed in June. A large freighter, nearing completion, will introduce this system of construction on the Lakes.

The ordinary method of building vessels consists of fitting closely spaced transverse members to hold the shell and deck plating up to their work, and to prevent local deformation. As is well known, however, the principal stresses on vessels, due to their loading and to the action of waves, are longitudinal. The longitudinal members of a vessel, such as the shell plating and the deck plating, have to be of sufficient scantling to withstand these stresses. On the Isherwood system the shell and deck plating are stiffened by longitudinal framing, which adds to the material available for resisting the longitudinal stresses, and enables a reduction to be made in the thickness of the shell and deck plating without any sacrifice of strength. Transverse stiffness is provided by transverses, or web frames, spaced about 12 feet apart, forming continuous belts across the vessel. By this combination of framing the strength of the vessel is maintained at a considerable saving in weight.

On account of adopting this method of framing the *Ruth* is able to carry at the same draft 120 gross tons of cargo more than the *Jean,* built on the transverse system and of the same dimensions. This is equivalent to a saving of 4 inches in draft. This larger carrying capacity materially increases the net earning capability of the vessel, and the first cost is not increased by the adoption of this system of framing, as the

weight of steel material worked into the hull is about 9 percent less on the *Ruth* than on the *Jean*. In certain classes of vessels the saving in weight is considerably greater than on the *Ruth*.

Although this is the first vessel built on the Isherwood system at the Newport News yard, the adaptability of the system to rapid construction is shown by the following building schedule:

Contract signed, Dec. 15, 1909. First material received in yard, Feb. 17, 1910. Keel laid, March 2, 1910. Framed, May 11, 1910. Plated, June 2, 1910. Launched, June 11, 1910.

Length over all	328 feet.
Length from fore side of stem to after side of rudder post	318 feet 6 inches.
Beam, molded	46 feet.
Depth, molded	24 feet 3 inches.
Load draft	20 feet.
Deadweight capacity at load draft	4,740 tons.
Coal bunker capacity	784 tons.
Cargo capacity	248,000 cubic feet.

The vessel is fitted with one triple-expansion engine; cylinders, 22 inches, 37 inches and 60 inches diameter by 42 inches

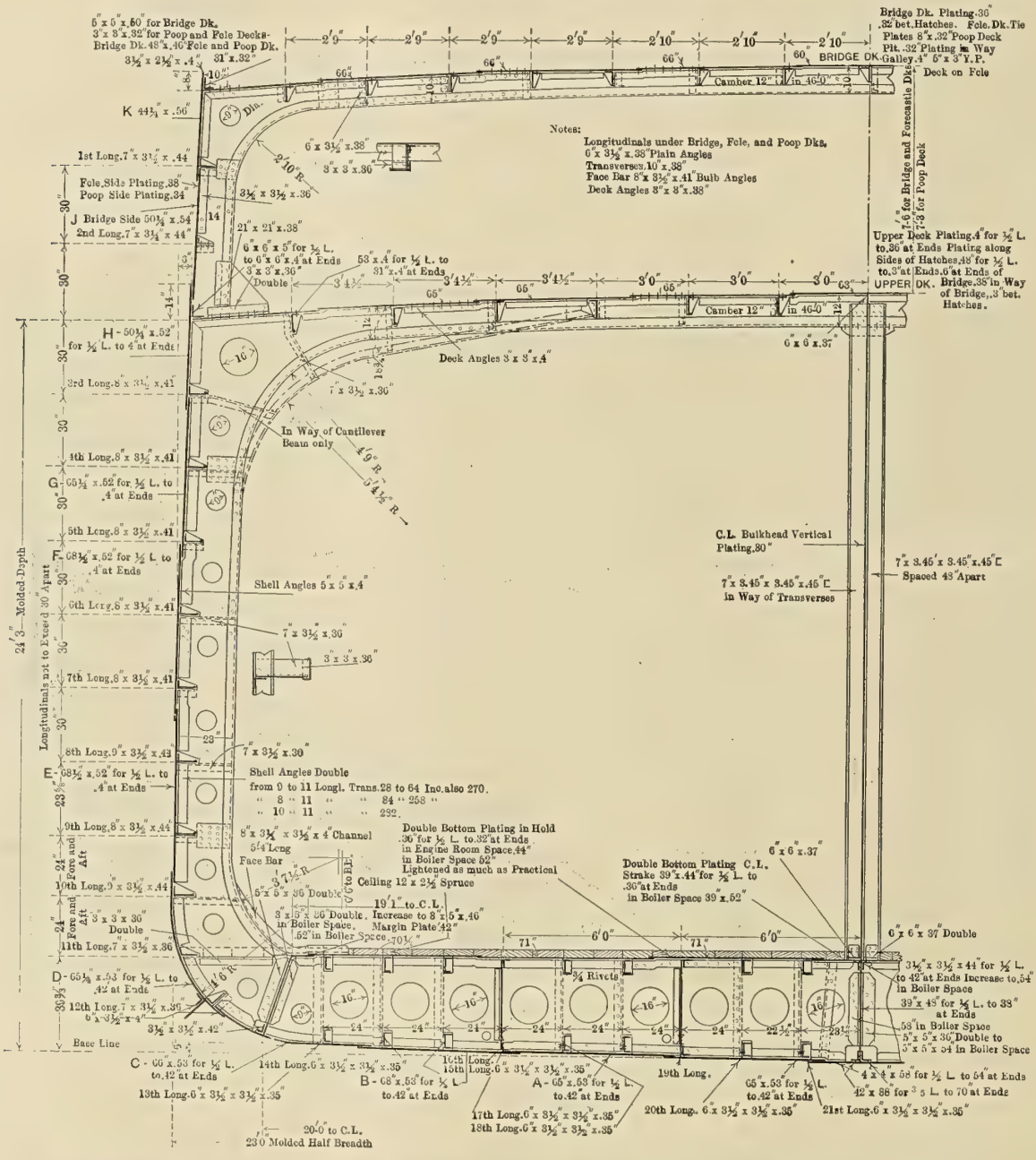

Bridge Dk. Plating.36" .32" bet. Hatches. Fcle. Dk. Tie Plates 8"x.32" Poop Deck Plt. .32" Plating in Way
BRIDGE DK.
Galley.4" 6"x 3" Y.P. Deck on Fcle
Notes:
Longitudinals under Bridge, Fcle, and Poop Dks. 6"x 3½"x.38" Plain Angles
Transverses.10"x.38"
Face Bar 8"x 3½"x.41" Bulb Angles
Deck Angles 3"x 3"x.38"
Camber 12" in 46'0"
Upper Deck Plating.4" for ½ L. to.36" at Ends Plating along Sides of Hatches.48" for ½ L. to.3" at Ends.6" at Ends of UPPER DK. Bridge.35" in Way of Bridge,.3" bet. Hatches.
Deck Angles 3"x 3"x.4"
In Way of Cantilever Beam only
C.L. Bulkhead Vertical Plating.80"
7"x 3.45"x 3.45"x.45" ⊏ in Way of Transverses
7"x 3.45"x 3.45"x.45" ⊏ Spaced 48" Apart
Shell Angles 5"x 5"x.4"
Shell Angles Double from 9 to 11 Longl. Trans.28 to 64 Inc. also 270.
" 8 " 11 " " 84 " 258 "
" 10 " 11 " " 282.
Double Bottom Plating in Hold .36" for ½ L. to.32" at Ends in Engine Room Space.44" in Boiler Space 52" Lightened as much as Practical
Ceiling 12"x 2½" Spruce
Double Bottom Plating C.L. Strake 39"x.44" for ½ L. to .36" at Ends in Boiler Space 39"x.52"
6"x 6"x.37" Double
¾ Rivets
Base Line
Longitudinals not to Exceed 30" Apart
Molded Depth 24'3"
Fore and Aft
20'0" to C.L.
23'0 Molded Half Breadth

FIG. 2.—MIDSHIP SECTION OF THE NEW BULL FREIGHTER, BUILT ON THE ISHERWOOD SYSTEM OF LONGITUDINAL FRAMING.

Engines installed, July 18, 1910. Dock trial, July 29, 1910. Completed and delivered, Aug. 6, 1910.

It will be noted that the vessel was on the stocks only three months and nine days, and was delivered in seven months and twenty-two days after the signing of the contract.

The general appearance of the vessel and the details of construction are shown by the illustrations. The following particulars may be of interest:

stroke; two Scotch boilers, 15 feet diameter by 10 feet 10 inches long, built for 180 pounds pressure, natural draft, and one donkey boiler, Scotch, 9 feet diameter by 10 feet 5½ inches long, built for 90 pounds pressure. There is a steam windlass, a steam capstan aft, an electric plant and five steam winches.

The vessel was built under special survey of British Lloyds to their highest class.

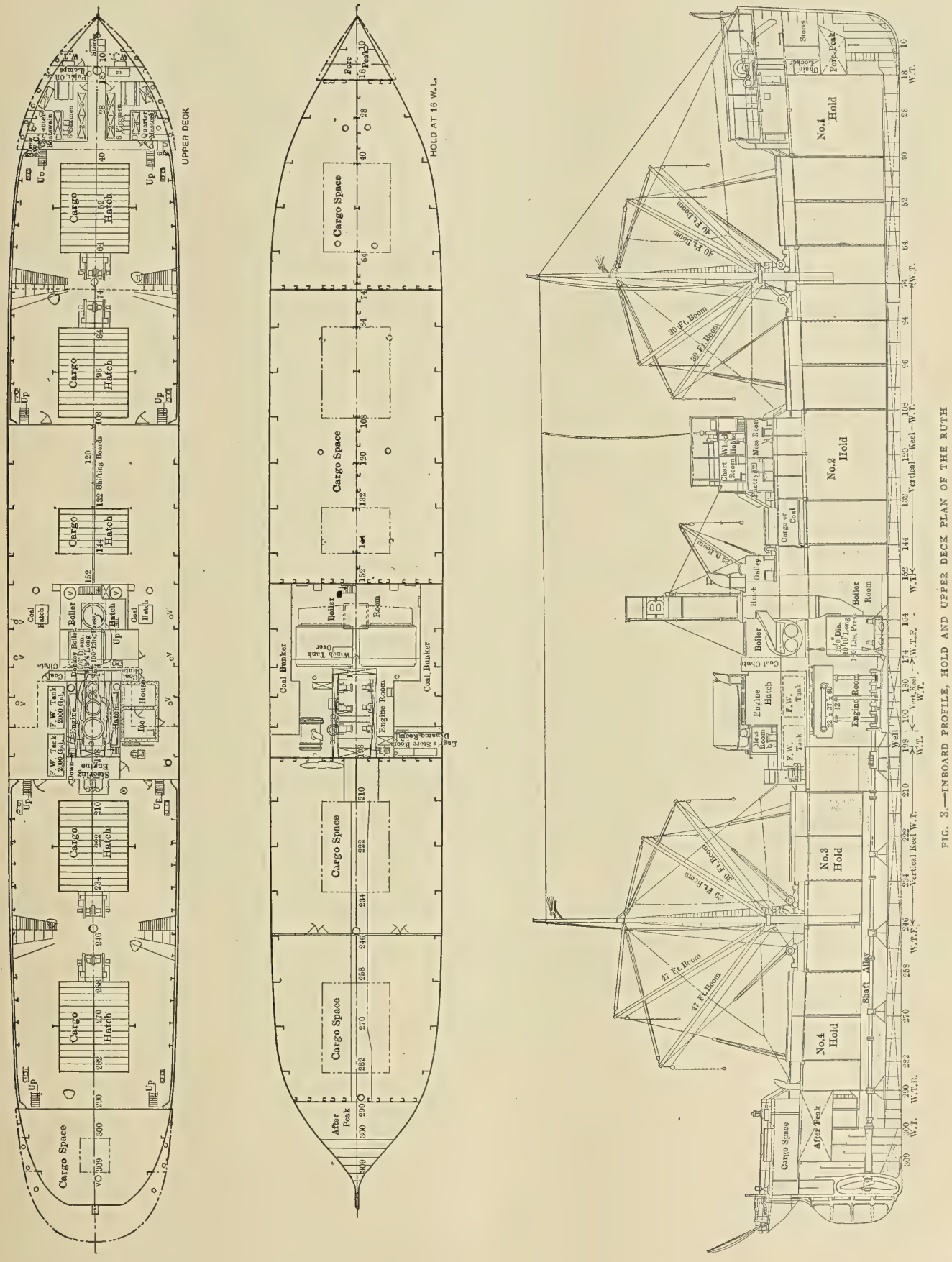


FIG. 3.—INBOARD PROFILE, HOLD AND UPPER DECK PLAN OF THE RUTH

THE BOAT PROBLEM.

BY SIDNEY F. WALKER.

In view of the very great importance, the literally vital importance, of boats to every class of seagoing ships, the fact is very striking that so little has been written upon the subject, either in the transactions of institutes or in technical journals. Though each successive great liner that has been launched has been described in very minute detail, it is difficult to find a sentence referring to the boats she carries, unless it happens to be in connection with some hoisting gear incidentally devoted to boats.

The boat problem divides itself into two—the boats required for men-of-war and those required by ships of the mercantile marine. And again the problem, so far as the mercantile marine is concerned, divides itself into two—the boats required by ships carrying passengers and those required by ordinary cargo ships. The boat question has followed, at some distance, the development which has taken place in the construction of ships themselves. Forty years ago the sailing ship still held the field, and ships were still largely built of wood. Iron was only then coming into use, and steel was practically tabooed. Now the sailing ship has almost ceased to exist, and the use of wood for the construction of seagoing ships of all classes has also almost ceased. At the present time the boat problem is passing through a transitory stage similar to that through which ships passed some thirty years ago. Steel is steadily making its way for boat construction, but it is still looked at with suspicion, just as iron was for ship building forty years ago. Steel-built boats have many advantages over wood building, but they still have some disadvantages. With the same propelling power they will not develop the same speed, and they will not stand the knocking about when lying alongside accommodation ladders or piers that the wood-built boat will without showing the marks. Hence, steel for boat construction is making its way slowly for men-of-war, and for a large section of the mercantile marine, on account of its greater cost, and the possibility, if care is not taken, of the boats being found badly damaged by rust, etc., when wanted.

FIG. 4.—STEAMSHIP RUTH, ONE OF THE FIRST LONGITUDINALLY FRAMED VESSELS BUILT IN AMERICA.

THE MAN-OF-WAR BOAT PROBLEM.

The man-of-war boat problem is quite different to the mercantile marine boat problem, because of the different conditions under which the two services are carried on. Both cargo and passenger steamers, on arrival at port, nearly always go right into dock or alongside a wharf to discharge, and take in cargo, and boats are therefore only required occasionally for officers' use and in case of disaster. Men-of-war lie always at a long distance from the shore, and the boats of the ship are required to take officers and crew to and from the shore, and from one ship to another in time of peace, and they are also required in war time to carry armed men and guns for attacking other ships or for landing. One requirement is common, however, to both the naval and mercantile marine in the matter of boats: every ship must carry a sufficient number with sufficient cubical capacity to accommodate all hands in case of wreck.

In the sixties and seventies, when wooden frigates were the largest naval vessels at sea, with an occasional two-decker and with a few of the ironclads as they were then called, wooden ships plated with iron, the boats carried by the largest men-of-war were as follows: Two launches, each pulling eighteen oars; one pinnace, pulling fourteen or sixteen oars; two cutters, pulling ten oars each; a smaller cutter, usually called the jolly boat, pulling eight oars; a galley, pulling six oars, single banked for the captain; a gig, pulling four oars, single banked for the commanding officer, and a dinghy pulling two oars. All of them carried crews corresponding to the number of oars, plus a coxswain and a midshipman or sub-lieutenant for each boat except the gig and dinghy. All of them also carried sails, the launches and pin-

nace being schooner rigged, the cutters, jolly boat, galley, gig and dinghy lug rigged. All of them were built of wood, the launches and pinnaces usually carvel, or with smooth skins, and the remainder clincher, the outside boards overlapping each other like the scales of a fish. When at sea the launches were stowed in crutches in the waist, between the fore and main mast, the pinnace and the smaller boats, except the two cutters, inside the launches. Two cutters were kept at the quarter davits, ready for lowering in case of a man overboard. In war time, when attacking other ships or shore defences, the launches and pinnaces carried small breech-loader guns, and in landing men for shore work one of the launches carried the field gun, which formed part of the equipment of large ships of those days. All of the crews carried rifles and side arms, and in addition the larger boats had a certain complement of marines.

FIG. 5.—PARTIAL VIEW OF THE AFTER HOLD OF THE S. S. RUTH, SHOWING LONGITUDINAL FRAMING.

At the present time the row boats carried are very much the same as in the old days, except that whale boats have been added and the larger boats are driven by steam. The steam launches, pinnaces and cutters do the greater part of the work of carrying officers and men and stores between the ship and the shore and from ship to ship. In steam-propelled boats there has been a continual development since about the year 1864, and it has been largely due to the work of Mr. J. Samuel White, of East Cowes, Isle of Wight. In the early sixties, Mr. White attacked the problem of the production of a lifeboat that was really unsinkable and the propulsion of the boat by steam, and he was so successful that the Admiralty adopted his ideas. At the present time steam pinnaces, as they are now called, 56 feet and 40 feet long, steam barges, 40 feet and 32 feet long, and steam cutters, 32, 27 and 23 feet long, are carried by the different classes of ships in the British navy. Battleships and cruisers carry two or three pinnaces of 40 feet or 56 feet length, according to the size of the ship, flagships carrying what is practically a steam pinnace for the use of the admiral called a barge. It takes the place of the twelve-oar barge of the sailing ship days. Smaller ships, second and third class cruisers, torpedo boat destroyers and surveying ships, carry steam cutters of different sizes, according to the size of the ship. The speed of the steam-driven boats has been gradually increased from 8.3 knots in 1867 to 19 knots, the speed of boats recently turned out for foreign governments, and the indicated horsepower of the engines carried by steam-service boats has increased from 31 to 300. Other developments have taken place, such as the substitution of watertube boilers for the locomotive type

employed in the early steamboats, the addition of condensers and forced draft, and a very large increase in the speed of the engine, from about 280 up to 550 revolutions per minute. The fuel capacity has been quadrupled.

The steam-driven boats of the British navy have so far only employed coal as a fuel, except in the case of boats permanently used in harbor service, in which oil fuel has been employed to a small extent. Attempts are being made, the writer understands, to adapt the heavy oil fuel that is now being carried in some of His Majesty's ships for boat service, but the use of gasoline (petrol) is looked upon with great suspicion, because of its inflammability. The writer understands, however, that in America gasoline (petrol) is finding greater favor. For men-of-war's boats internal-combustion engines of all kinds are at a serious disadvantage, as compared with steam engines, on account of the greater convenience of control of the steam engine. When a large fleet is at anchor, say at Spithead or at Hampton Roads, there is an enormous amount of traffic between the individual ships and the flagships, and the question of keeping the accommodation ladder clear, for the different officers as they arrive, is often a very troublesome one to the officer and midshipmen of the watch. Boats come alongside, discharge their officer, or whomever they may bring, and are obliged immediately to clear off to make way for another boat. Naval etiquette also demands that a junior officer, who may be coming alongside, and who sees a senior officer about to come, should get out of his way, if necessary not going alongside until his senior has gone on board. All this requires very complete command of the boat, the ability to go easily or quickly ahead or astern at very short notice, and so far, for this purpose, steam is the ideal power. In the old days, whenever there was wind enough, midshipmen of boats delighted in sailing, and it was splendid exercise, considerable skill being required to bring a boat nicely alongside the gangway when approaching under sail. It is probable, however, that in the near future oil fuel and the internal-combustion engine will come in for men-of-war's boats with the advances that are being made in the flexibility of oil engines.

BOATS FOR THE MERCANTILE MARINE.

The boats carried by the mercantile marine are governed entirely by the number on board. In the United Kingdom, the Board of Trade have an elaborate set of rules governing the minimum number of boats that each ship must carry and their cubical capacity, the rules being based upon the ability of the boats to save all hands in case of wreck. The boats carried must provide 10 cubic feet of boat capacity for each adult person on board the ship, or alternatively, they may carry a certain number of boats and a further capacity in life rafts and other appliances to make up the difference, the capacity in life rafts or other appliances being larger in proportion than is required in boats. Life rafts are required to have an air capacity of 3 cubic feet for every adult person. Thus with large liners of 10,000 tons and upwards gross, carrying passengers, the minimum number of boats is sixteen, and the cubical capacity 5,500 cubic feet, smaller ships carrying passengers have a smaller number in proportion. The American law requires a further addition for the large ships that have been recently introduced. A ship of 24,000 tons gross tonnage, say, carrying passengers, must have a certain number of additional boats, partly of the ordinary build and partly collapsible. Of the boat capacity required by the British Board of Trade, ships of 10,000 tons gross register carrying passengers would have fourteen lifeboats, each 30 feet long 9 feet wide and 4 feet deep, and two cutters 25 feet long 7 feet wide and 3 feet deep.

The lifeboats carried by passenger ships are of the whaleboat form, with bow and stern built alike and with air chambers formed, either in the boat itself or carried outside the boat, sufficient to give buoyancy such that, with the boat full of water, and with its full complement of crew and passengers it would be impossible to submerge it. They are also fitted with life lines running round the outside of the boat in loops, so that persons in the water may catch hold of them and be drawn into the boat. The lifeboat, it will be remembered, has been developed from the boat that has been carried by whaling ships almost as long as the whale has been hunted, and which has been found so handy in a heavy seaway.

Cargo steamers, of which the tramp class form the larger proportion, carry only a small number of boats, because they have only a comparatively small number of hands. Tramp steamers carry two lifeboats, one on each side of the ship, the two boats being of sufficient capacity to carry all hands and being kept ready to lower at short notice. The writer understands that usually one boat will carry the whole crew. Two smaller boats are also kept for use when the ship is in port, if she happens to be lying in the roads for a short time, to convey the captain or crew to and from the shore. These are the usual square-stern gig or dinghy type.

The lifeboats carried by the passenger ships and by cargo steamers are required by the British Board of Trade rules to be kept under davits; that is to say, ready for immediate use. As those who go down to the sea in ships know, sometimes to their cost, and as those who read the daily papers will have learned also, in cases of collision the time allowed for getting out of the ship is nearly always very short indeed. In cases also where the ship has to be abandoned, owing to damage in stormy weather, the facilities with which the boats can be got out and lowered under the severe conditions which then rule have a very important bearing indeed upon the question whether the lives of the crew can be saved or not, and whether they get one more chance of reaching home. Lowering a boat at sea, even under the most favorable conditions, is a difficult matter. The writer proposes to deal with the whole of this in a later article.

BOAT CONSTRUCTION.

In the old days all boats were constructed of wood, some being built on the carvel system and others on the clincher system. The carvel system, which was employed for the larger boats, such as launches and pinnaces, in the British navy, but which was also employed to a certain extent in boats built for the mercantile marine, and is even up to the present day, may be described as diagonal planking. It presented a smooth surface to the water on the outside, but for smaller boats was not considered so strong as clincher construction. The large steam-driven boats of modern men-of-war used in the British navy are carvel built, with two and sometimes three skins, each consisting of diagonal planking, the direction of the planks being arranged to cross each other, and the two, or the three skins, being separated by layers of waterproof canvas, etc.

In clincher-built construction the boats were formed of a number of planks, running fore and aft, and lying over each other like the slates on the roof of a house. All wooden-built boats are formed on a frame of ribs, keel, stem and stern post, the timbers forming the skin of the boat being secured to the framework by copper bolts and by inner members, known as the keelson, false stern post and stemson. The construction is, in fact, on very much the same lines as that of a ship. With steel boats, however, a different system of construction has been introduced which does not depend so much on the framework.

STEEL BOATS.

The steel boats which are being built for the mercantile marine are made on something the same lines that the large

coal wagons are constructed. Each boat is stamped out from sheet steel in two halves, just as the sides and other frame members of railway wagons are, by hydraulic pressure. The two halves are bolted together along the line of the keel, stem and stern post, and are then fitted with wooden thwarts, bottom boards, stern sheets, etc. The steel boats of this type are made in practically all sizes by the Seamless Boat Company, of Wakefield. Some steel boats have also been built by Messrs. J. Samuel White & Company for foreign governments, the steel employed being galvanized hot.

COLLAPSIBLE BOATS.

In addition to wood and steel a class of boats has been developed for use in the mercantile marine designed to occupy smaller space on board ship than either wood or steel, and therefore to enable a larger proportion of boat capacity to be carried in a smaller space. Of these, one of the best known is the Berthon, which may be described as built up of a number of canvas members. Each canvas member consists of a framework of wood, forming part of the frame of the contour of the boat when in place, and having two sheets of specially prepared canvas stretched over them. When the boat is not in use the frames, with their canvas covers, fold up together very much as the leaves of a book fold, the keel taking the place of the back of the book and the leaves the canvas-covered frames, being attached to the keel, the stem and stern post. The thwarts, bottom boards and other inside fittings, which are of wood, are made in halves and hinged in the center, so that they also fold up inside the boat when the latter is stowed. The thwarts are supported by stanchions in the usual way, and are fitted with hooks for lowering and the other appliances necessary for ordinary boat work. When stowed they lie flat against the ship's side, or wherever it may be convenient to stow them, with their oars and other appurtenances carried between the sides of the boat. For ship work the boats are usually made on the whale or double-bowed system, and they are constructed of sizes ranging from 7 feet in length up to 28 feet. The canvas employed in their construction is especially strong, it having a breaking strain, cut longitudinally, of 570 pounds per inch of width, and when cut transversely of 370 pounds. It is claimed that the two canvas skins employed in the frames act as the air vessels in the ordinary lifeboat, rendering the boats unsubmergible. It is also claimed that the two skins give an immunity from damage such as could not be obtained with one skin. The boats are fitted with sails and oars just as ordinary boats, and one of them is stated to have sailed from Southampton to Liverpool. The Berthon boats are carried by several of the large ocean liners, but do not appear so far to have been adopted by the tramp class of steamer.

Another collapsible boat, built upon different lines, is the Engelhardt, made by the Lane & De Groot Company, New York, which is also claimed to be unsinkable and to have the advantage of occupying very much smaller space than the ordinary boat, while being ready for instant use. The Engelhardt boat is built to close up vertically, something on the lines of a concertina. The boats are built in various sizes, from 12 feet long by 5 feet wide up to 28 feet long by 9 feet wide. The 12-foot boat has a depth of 1 foot 9 inches when in use, and 1 foot when collapsed for stowage. The larger boats having a depth when extended for use of 2 feet 8 inches and when collapsed for stowage of 1 foot 6 inches. When at sea the Engelhardt boats are stowed in a nest one above the other, and can be triced out and lowered into the sea by suitable tackle, one after the other, as may be required.

The Institution of Electrical Engineers has moved to Victoria Embankment, London, W. C.

ON THE POWERING OF SHIPS.

BY SIDNEY GRAVES KOON, M. M. E.

When it becomes necessary to determine, for any new ship, the power required to drive her at a predetermined speed, several methods are in use, of which the most common is that employing what is known as the Admiralty formula:

$$H = \frac{D^{2/3} V^3}{K},$$

where H is the horsepower for speed V, expressed in knots; D is the trial displacement in tons, and K is a coefficient, called the Admiralty coefficient, or, sometimes, the Admiralty constant.

But K is not a constant. It varies with varying forms of ships, becoming larger as the form becomes finer and better fitted for maintaining the desired speed. It varies with the size of the ship, becoming very slowly larger as the size increases. It varies with the speed of the ship, becoming smaller as extreme speeds are reached, and larger when a more moderate performance is approached.

It is in the assumption of this coefficient K that the genius and experience of the naval architect are brought into play in connection with the designing and powering of a new ship. He has before him a mass of data on the performances of previous ships, from which the coefficient has been deduced by a reversal of the formula into

$$K = \frac{D^{2/3} V^3}{H}.$$

He has in mind the form and general proportions of the new ship. He goes over his data until he finds a case which approximates, more or less closely, to the one in hand. And then the value is chosen and the required power computed.

In this latter operation he usually allows a slight margin for the unexpected, and as a result is disappointed, if on the trial trip the ship does not do a little better than demanded by the contract. But it may here be stated, as a general proposition, that a unit which develops 10 percent more power than that for which it was designed, gives just as poor a result, from the standpoint of mere design, as does that which falls short in the same ratio. From the broader commercial viewpoint of fulfilling the conditions of the contract and providing a definite result, however, any excess is usually welcomed, unless purchased at the expense of something else, such as economy or margin of safety.

For the purpose of illustrating some of the problems involved, and of affording opportunity for elaborating upon them, a list of some twenty types of battleships (Table I) and as many of armored cruisers (Table II.) has been prepared,* which gives the main particulars of the design, so far as powering is concerned, and similar data for the actual trial performances. In the *latter*, in order to eliminate irregularities due to stress of weather or other disturbing elements, the results are shown as the *averages* of a number of ships of the same types, the number so included being indicated, and being, with a few exceptions, the total number of that type built. In this manner it has been possible to give results covering more than 150 prominent vessels in the compass of a list tabulating 41. The ships are selected from the lists of the seven leading navies.

A cursory examination of the tables shows that, with the sole exception of the Italian *Regina Elena* (three ships), among the battleships, and of the French *Jeanne d'Arc* among the armored cruisers, all of the vessels listed have exceeded the required speed; the maximum excess being 1.29 knots in

* It is usually difficult to obtain sufficiently comprehensive data from the trials of merchant ships.

TABLE I.

Ship.	Design.					No.	Result.				
	Tons.	*b. c.*	Horse-power.	Speed.	*K.*		Horse-power.	Speed.	*K.*	Excess Power.	$\frac{V}{\sqrt{L}}$
Jupiter	14,900	.634	12,000	17.5	270	8	12,300	18.26	294	2.5%	.914
Ocean	12,950	.602	13,500	18.25	248	6	13,835	18.41	249	2.5	.92
London	15,000	.637	15,000	18.	236	8	15,405	18.26	240	2.7	.901
Triumph	11,800	.516	12,500	19.	284	2	13,750	20.11	307	10.	.94
Duncan	14,000	.586	18,000	19.	221	6	18,271	19.07	221	1.5	.933
Dominion	16,350	.625	18,000	18.5	227	8	18,444	18.83	233	2.5	.899
Agamemnon	16,500	.633	16,750	18.	226	2	17,365	18.82	249	3.7	.913
Dreadnought	17,900	.555	23,000	21.	*275	1	24,712	21.25	†266	7.4	.932
Nebraska	14,948	.659	19,000	19.	219	5	22,148	19.1	192	16.6	.916
Idaho	13,000	.643	10,000	17.	272	2	13,563	17.13	206	35.6	.885
Kansas	16,000	.667	16,500	18.	224	6	18,895	18.51	214	14.5	.873
Michigan	16,000	.633	16,500	18.5	244	2	17,334	18.83	246	5.	.888
Delaware	20,000	.597	25,000	21.	*a*273	2	*b*32,130	21.6	234	28.2	.956
Gaulois	11,260	.601	14,500	18.	202	2	15,108	18.08	196	4.1	.926
Patrie	14,635	.54	17,475	18.	200	6	19,370	19.29	222	10.9	.921
Wettin	11,643	.596	15,000	18.	200	2	14,928	18.12	205	.....	.906
Elsass	13,000	.59	16,000	18.	202	9	17,685	18.58	200	10.5	.918
Margherita	13,214	.514	19,000	20.	235	2	20,532	20.3	228	8.1	.982
Flena	12,425	.5	20,000	22.	286	3	21,150	21.89	268	5.8	1.015
Mikasa	15,200	.619	15,000	18.	238	4	16,500	18.68	242	10.	.917
Kashima	16,400	.605	17,000	18.5	240	1	17,280	19.24	266	1.5	.901

* Equivalent for I. H. P.—242. † Equivalent for I. H. P.—234. *a* Equivalent for I. H. P.—240. *b* Equivalent for I. H. P.

TABLE II.

Ship.	Design.					No.	Result.				
	Tons.	*b. c.*	Horse-power.	Speed.	*K.*		Horse-power.	Speed.	*K.*	Excess Power.	$\frac{V}{\sqrt{L}}$
Cressy	12,000	.507	21,000	21.	231	6	21,358	21.61	248	1.7	1.014
Drake	14,100	.519	30,000	23.	237	4	31,094	23.2	235	3.6	1.022
Berwick	9,800	.482	22,000	23.	253	10	22,494	23.27	257	2.2	1.109
Argyll	10,850	.503	21,000	22.25	257	6	21,531	23.13	282	2.5	1.09
Natal	13,660	.502	23,500	22.33	271	6	23,757	23.17	299	1.1	1.058
Shannon	14,600	.511	27,000	23.	269	1	28,553	22.6	241	5.8	.992
Minotaur	14,600	.499	27,000	23.	269	1	27,856	23.01	261	3.2	1.01
Milwaukee	9,700	.516	21,000	22.	231	3	25,841	22.13	191	23.1	1.075
Colorado	13,680	.572	23,000	22.	265	6	27,427	22.28	232	19.2	.994
Tennessee	14,500	.557	25,000	22.	253	4	27,781	22.29	238	11.1	.995
Jeanne d'Arc	11,092	.482	28,500	23.	212	1	28,900	21.7	176	1.4	.995
Montcalm	9,367	.464	19,600	21.	210	2	20,021	21.14	210	2.2	.993
Gloire	9,856	.486	20,500	21.	208	4	21,888	21.61	212	6.8	1.015
Gambetta	12,351	.493	27,500	23.	236	4	28,457	23.01	229	3.5	1.055
Renan	13,347	.481	37,000	23.	185	1	37,780	24.2	211	2.1	1.066
Yorck	9,348	.516	19,000	21.	216	2	20,460	21.29	209	7.7	1.061
Scharnhorst	11,319	.509	26,000	22.5	221	1	27,759	22.71	213	6.8	1.079
Nisshin	7,700	.507	14,000	20.	223	2	14,916	20.15	214	6.5	1.066
Asama	9,750	.515	18,000	21.5	252	2	19,417	22.58	271	7.9	1.118
Iwate	9,750	.514	14,500	20.75	281	2	15,909	21.89	301	9.7	1.095
Bayan	7,726	.498	16,500	21.	219	2	18,508	22.28	234	12.2	1.058

the French *Patrie* (six ships), 1.28 knots in the Russian *Bayan* (two ships), and 1.2 knots in the French *Renan;* all of these ships having been built in France.

Closer examination reveals the fact that the British ships, almost without exception, have given on trial better results, as measured by the Admiralty coefficient, than the design called for. The American ships, on the other hand, with the single exception of the *Michigan* (two ships), have fallen far short of propulsive expectations, though all have attained the required speed. It will be further noted that all of the American ships (again with the exception of the *Michigan*) have exceeded their designed power by more than 11 percent; while none of the other vessels, with the exception of the *Bayan,* has exceeded by so much as 11 percent; in more than one-half the cases the margin is less than 4 percent. Either the American designers have allowed unusually liberal margins for excess power, amounting to over 23 percent in the cases of seven of the vessels listed, or these vessels have been hard pushed to develop the required speed, and as a direct consequence the last atom of power, if so we may express it, has been extracted in the attaining of this speed. However this may be, an examination of some of the elements leading to the attainment of the trial results may prove profitable.

Generally speaking, there are three elements which, taken together, determine the speed to be attained by any ship. The first and foremost is, most naturally, the power of her engines. A second and very powerful influence lies in the proportioning of the propellers and their location relative to the hull, and to the steam lines when the ship is in motion. Last, but not least, we have the form of the ship herself, both as regards the block and prismatic coefficients and as regards the wave contour thrown up by the hull when in motion.

Taking up, first, the subject of power, we may note that in every average case cited, with the exception of the German *Wettin* (five ships), the engines have developed on trial somewhat more than the designed power. This, together with the fact that the designed speed has generally been exceeded, disposes at once of the question of the adequacy of this element. In this connection, however, we may here remark that the newer ships, fitted with turbines, have a great advantage in this respect; for, as is well known, the turbine will respond nobly to excessive forcing, and that with very slight loss of efficiency as compared with full power. The piston engine, on the other hand, usually calls for an excessive amount of steam from the boilers once the limit of fairly easy working is passed. This means that, with equal boiler power and with equal engine power under "easy" conditions, the turbine would more effectively utilize the ultimate forcing of the boilers, and would, on the same steam consumption, impart a greater propulsive effect through the shafts. On the other hand, it is usually easier to fit propellers of high efficiency to reciprocating engines, because of the fact that screw propellers operate most effectively at relatively low speeds of revolution—speeds lower than are usual in turbine installations.

Regarding the subject of propellers, reams have been written and more reams are to come. We shall confine ourselves here,

however, to discussing a few phases of the question, mainly as illustrating the cases listed.

The four cruisers of the *Drake* class (British, 14,100 tons displacement) have been subjected to exhaustive experiments to determine the proper form and pitch of propellers to obtain the best propulsive results with this particular hull. Some of the data so acquired are embodied in Table III., and are shown in three sets of curves, one of which relates the Admiralty coefficient to the indicated horsepower; a second shows Admiralty coefficient plotted on speed, while the third depicts the relation between speed and apparent slip of the propellers.

TABLE III.

Ship.	Pitch.	I. H. P.	Speed.	*K.*	R. P. M.	Slip.
King Alfred..	23 ft. 9 ins..	6,743	15.17	302	72.3	10.5%
		21,450	21.6	274	104.9	12.2
		22,540	21.98	275	106.7	12.1
		31,156	23.46	242	120.2	16.7
Leviathan....	23 ft. 9½ ins.	6,481	15.24	319	71.2	8.9
		22,900	21.96	270	107.6	13.1
		31,592	23.25	232	122.1	18.9
Good Hope...	22 ft. 9½ ins.	2,689	10.6	259	51.	7.6
		5,096	13.63	290	65.8	7.9
		6,054	14.5	294	71.1	9.3
		7,953	15.91	296	77.5	8.7
		12,108	18.1	286	90.	10.6
		16,960	20.58	300	99.8	8.3
		22,478	22.09	280	109.1	10.
		22,703	22.09	277	109.9	10.6
		31,071	23.05	230	125.	18.
Drake.....	24 ft. 6 ins..	6,937	15.43	309	72.3	11.7
		23,103	22.08	272	105.9	13.8
		30,557	23.05	234	116.	17.8
	23 ft. 0 ins..	31,409	24.11	260	122.4	13.2

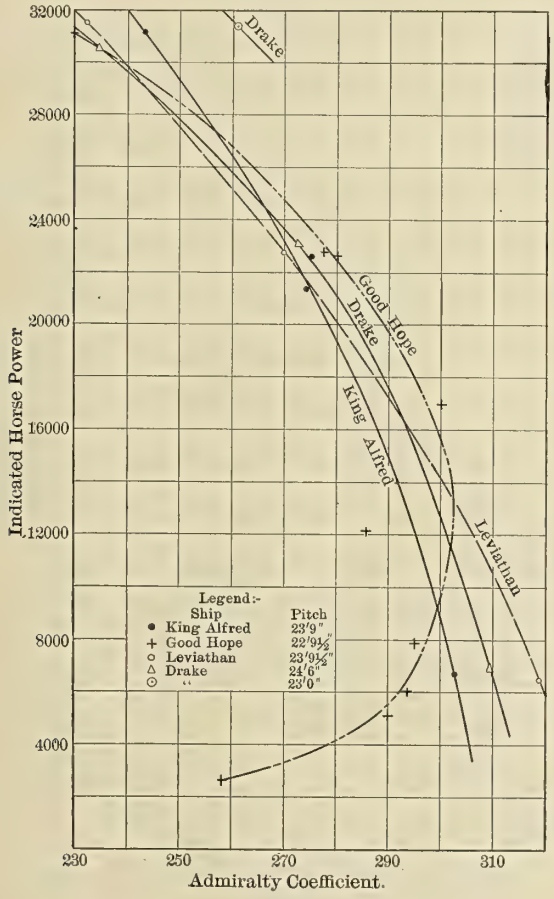


FIG. 1.

In each case we find an insufficient number of points to properly outline a curve upon which reliance can be placed, but the curves drawn may be considered fairly representative of the conditions obtaining. The one decidedly discordant point shown for the *Drake* was the result of fitting propellers of lower pitch and much increased blade area. The other cruisers have since been fitted with similar wide-bladed propellers, and have achieved equally good results. The third set of curves shows discordant points for the *Good Hope.*

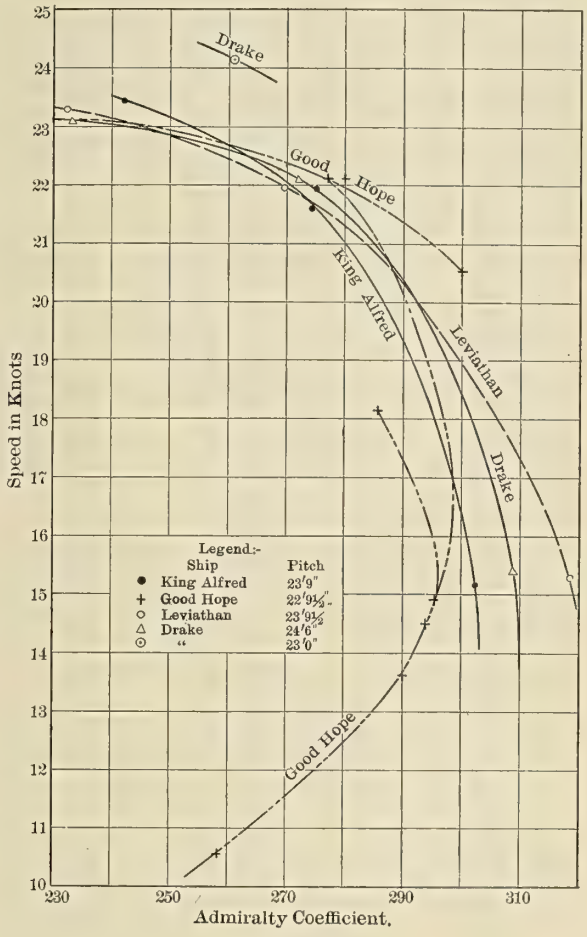


FIG 2.

A somewhat different result was obtained with the (three) propellers of the *Scharnhorst,* where an increase in pitch from 21 feet 3 inches to 24 feet 3 inches secured an improvement in the result, as follows:

Pitch.	I. H. P.	Speed.	K.	R. P. M.	Slip.
21 feet 3 inches....	27,759	22.71	212.7	120.2	9.9%
21 feet 3 inches....	18,052	20.69	247.3	107.3	8.0
24 feet 3 inches....	25,227	22.64	231.9	107.1	11.7
24 feet 3 inches....	16,695	20.45	258.2	95.1	10.2

Under full power, and also on the twenty-four-hour trial, the slip ratio has been increased by the change; but as the speed has been attained on a lower power, and with, presumably, a decreased fuel consumption, the result cannot but be regarded as satisfactory. For a short distance the *Scharnhorst* has made 24.1 knots.

Nearly all new power installations on warships provide for propulsion by steam turbines. This has made it necessary, in most cases, on account of the high speed of revolution, to resort to the use of relatively small propellers on three or four shafts. As the number has increased there has been an added amount of interference in the steam lines—the "wing" propellers, well forward, working in comparatively "solid" water, while the inboard, or after propellers, are compelled to operate in water already more or less disturbed by the action of the

forward set. This results in a heavy loss of efficiency, and it is now proposed to so design turbines as to utilize the entire power on two shafts, thus doing away with this disadvantage. This is already being done in Curtis installations, and it is expected that, at least for full-bodied models, the Parsons type will shortly fall in line. With fine-ended vessels this interference becomes less marked, for it is possible to place the wing propellers so far forward as to diminish, to a large extent, the swirl of water in which the inner propellers work; but for battleships the problem is decidedly important.

What effect the Melville spiral speed-reducing gear is destined to have on this question it is difficult to predict. It would appear that the saving in weight and space effected by

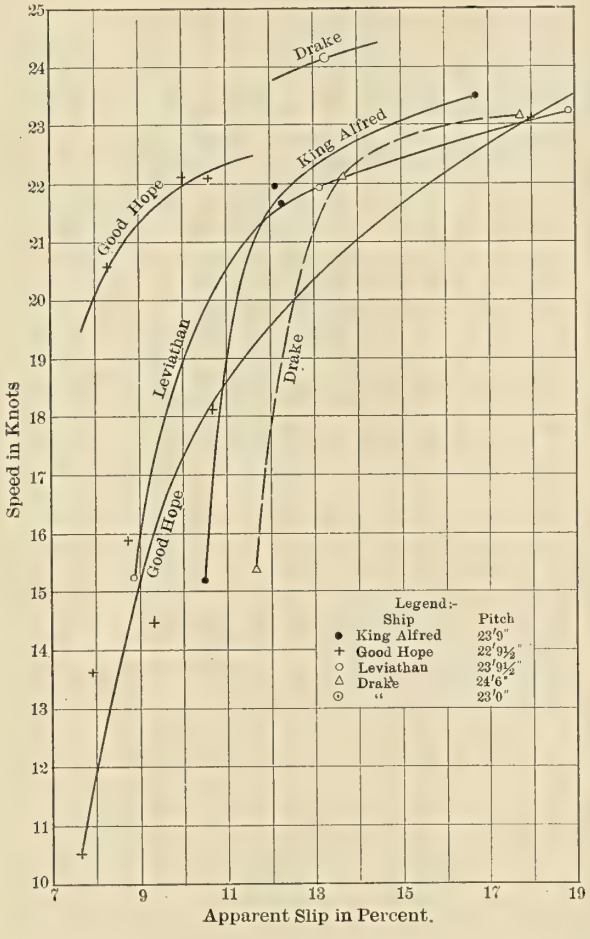


FIG. 3.

the use of faster-running turbines would be largely offset by the gears themselves; while the friction loss in the gears must needs be very small indeed to avoid neutralizing the gain in efficiency from the use of slower-running propellers. Propellers and shafting would be heavier than at present.

Our fourth diagram represents the relationship between block coefficient and Admiralty coefficient for the vessels listed. As might have been anticipated the points are "all over the lot." As a general proposition, however, it may be said that the higher the block coefficient the lower the Admiralty coefficient, and vice versa. In a few cases it has been possible to draw fairly representative curves, such as those for British armored cruisers, Elswick ships, French armored cruisers (the *Bayan* was built in France), and a line through the field of American battleships. One interesting feature is the fact that all of the vessels above and to the right of the line *A B C* (the richest part of the diagram, so far as performance is concerned) are Anglo-Saxon in both design and construction. It

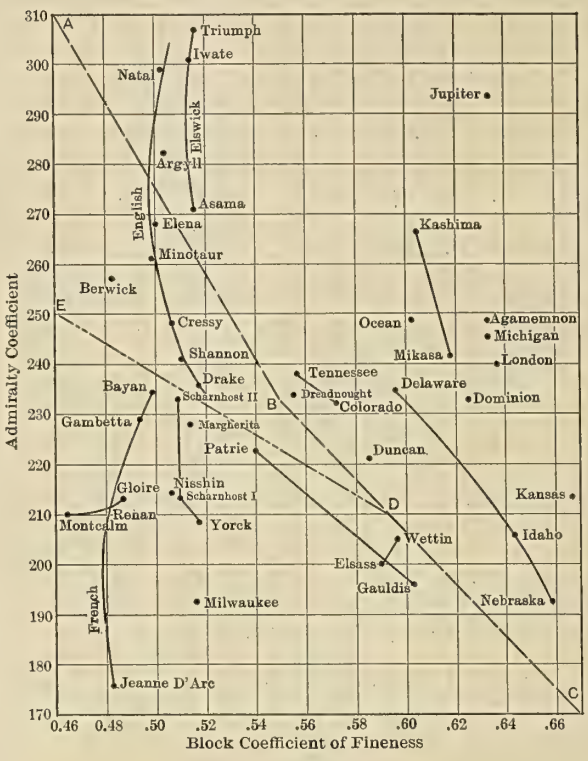


FIG. 4.

will be further noted that, aside from the *Regina Elena* (Italian, four ships), all of the vessels above and to the right of *E D C* are Anglo-Saxon; while the ineffective American *Milwaukee* (three ships) provides the sole Anglo-Saxon spot below this line.

So many other features enter into the problem that it is practically impossible to satisfactorily relate the two elements forming the ordinates and abscissæ of this diagram. Among

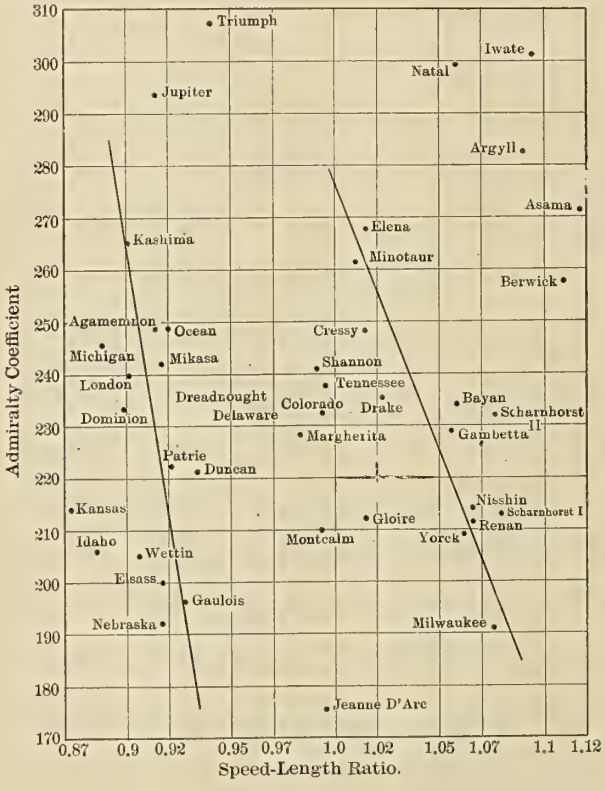


FIG. 5.

the important items affecting the result may be mentioned the relation of speed to square root of length. As this ratio increases above unity the problem of propulsion becomes harder to solve economically, and when it is above 1.2 it is usually undesirable to make the sacrifices in other directions which the speed demands.

A fifth and final diagram shows the relation between Admiralty coefficient and this speed-length ratio. It is found possible to draw a straight line, which represents, in some measure, the relation between these two elements for battleships and another for armored cruisers. It will be noted that in both cases the general trend is towards a higher Admiralty coefficient as the speed-length ratio decreases; also that the speed-length ratio attainable with the finer-formed cruisers is much greater for given propulsive efficiency than with the heavier battleships. The *Regina Elena* seems to be more closely allied with the cruisers than with the battleships; the same is true, in smaller measure, of the British *Triumph* (two ships). In both cases the lines are very fine, the block coefficient lying in the region usually assigned to fast cruisers. A collection of English-built cruisers in the upper right corner shows the best results of all. These are all vessels of fine form, and, apparently, with hulls exceptionally well designed and proportioned.

Attention may be directed to the American *Milwaukee* class (three ships) and the British *Berwick* class (ten ships):

	Tons.	I. H. P.	Speed.	K.
Milwaukee	9,700	25,841	22.13	191
Berwick	9,800	22,494	23.27	257

These two classes are of about the same dimensions and displacement, but the British vessels have the finer lines. They have the same batteries, and were designed for nearly the same horsepower. But the British vessel was expected to attain an extra knot of speed—and did so, though handicapped by having 13 percent less power. Could the American vessels have attained an Admiralty coefficient as high as that of the *Berwick* class (257), the mean trial speed on full power, with the engine power actually developed, would have been increased from 22.13 to 24.43 knots—a gain of 2.3 knots, or 10.4 percent. To attain this speed with the *Milwaukee's* Admiralty coefficient would require the development of 34,754 horsepower, or 8,913 more than the power attained on trial, and 13,754, or 65.5 percent, more than the design called for. A still more startling result may be shown by comparison with the Elswick-built Japanese cruisers *Asama* (two ships) and *Iwate* (two ships).

The table shows results for the *Shannon* and the *Minotaur*. These two ships, with a third, the *Defense,* were built at a time when discussion was rife on the relative merits of straight vs. hollow waterlines. In order to test out this matter the *Shannon* was built with hollow lines and the other two with straight lines. All three vessels are 519 feet long on the waterline and displace 14,600 tons; but while the *Shannon* is 75½ feet wide and draws 25½ feet of water (mean), the others are 74½ feet wide and draw 26½ feet. The *Minotaur* has a somewhat finer form than the *Shannon*. On trial the hollow-lined ship developed 700 more horsepower than her rival, but fell short 0.41 knot in speed. With the same horsepower for both vessels the loss of speed in the hollow-lined ship would have been 0.59 knot.

Most of the latest ships have benefited from the performance of tank experiments upon models. These experiments have frequently been the means of determining the forms of important ships, and are becoming more and more useful as our knowledge of their applications and limitations increases. A particularly good example of the beneficial results attending this manner of testing a drawing-room design lies in a comparison of the results given for the *Kansas* (six ships) and for the *Michigan* (two ships). Both types are of the same length, draft and displacement, and were designed for the same engine power. But the later *Michigan* was given 4 feet extra beam (80 feet, molded, in place of 76), and the lines so fined as to bring the displacement to the same figure as with her predecessors. Tank experiments showed that ½ knot better speed could be anticipated on the same power. The result showed 0.32 knot better speed with 1,561 horsepower less. Had the *Michigan*'s engines developed the power actually attained by the *Kansas* class, her speed would have been (with her own Admiralty coefficient) 19.38 knots, or 0.87 knot better than the older type. This shows the value both of fine lines and of tank experiments for determining which, of several sets of proposed lines, will be most likely to give best results.

An example showing the relative suitability of certain ranges of speed for a given vessel is obtained by considering the trial results of the *Idaho* and *Mississippi,* as follows:

	I. H. P.	Speed.	K.	
Idaho	13,765	17.14	203.2	Full power trial.
Mississippi	13,361	17.11	208.6	
Mean	13,563	17.125	205.9	
Idaho	7,476	15.14	257.8	24-hour trial.
Mississippi	7,215	15.13	267.1	
Mean	7,345	15.135	262.5	

These ships are short and "stubby"—375 feet waterline by 77 feet beam; and though the block coefficient is but 0.643, they are obviously much better fitted for the more moderate speed. This lower speed, obtained on twenty-four-hour trial, would have required, at the Admiralty coefficient of the four-hour full-power trial, no less than 9,364 horsepower, or 2,019 (27.5 percent) more than was actually developed for the lower speed.

The trials of the *Delaware* and *North Dakota* afford a final example for comparison. These are twin-screw sister ships of 20,000 tons displacement, fitted, respectively, with reciprocating engines of 25,000 indicated horsepower (designed), and Curtis turbines of 25,000 shaft-horsepower (designed). The trials at full power produced:

	I. H. P.	S. H. P.	*V.*	*K.*	*K'.*
Delaware	28,578	.....	21.563	258.5	.....
North Dakota	.....	31,400	21.64	.....	237.8

Assuming the usual 88 percent engine efficiency, the *North Dakota's* equivalent in indicated horsepower would be 35,682, and her Admiralty coefficient 209.3, a considerable reduction, and a very decided drop from that given by the performance of her sister ship. This example illustrates the great adaptability of the steam turbine for overloading, as mentioned above.

This is merely a desultory study of a few of the more important points entering into the powering of large ships. It attacks a few of the problems involved, and shows something of the underlying causes affecting the results. It is analytic and critical, rather than constructive, for no attempt is made to furnish a panacea for propulsive weaknesses. It may, however, offer some pertinent suggestions to the thoughtful mind.

Errata.—In the August instalment of the serial article on "The Marine Steam Engine Indicator," the following errors occur: On page 318, near the top of the second column, the sentence beginning "The drum end should be examined, etc., should read, "The drum cord should be examined for chafe, etc.," and further on, in the same paragraph, the sentence, "If fouling is indicated remove the piston at once, wipe it off with cloth—not water—etc.," should read, "If fouling is indicated, remove the piston at once, wipe it off with cloth—not waste—etc."

A NEW LAKE PASSENGER STEAMER.

The latest addition to the fine fleet of passenger steamers of the Great Lakes of North America is the new steel steamer *Alabama,* just delivered to the Goodrich Transit Company of Chicago, Ill., by the Manitowoc Dry Dock Company, Manitowoc, Wis. This steamer is probably the most complete and elaborate craft of her size and kind on fresh water, and no expense has been spared to proide for the safety and comfort of the passengers. The subdivision of the hull by an unusually large number of watertight bulkheads makes the ship practically unsinkable, and a complete automatic sprinkler system as well as special fire pumps affords absolute fire protection. All conveniences known to modern ships, such as wireless telegraph outfits, refrigerating plant, running water in staterooms, drinking water systems, etc., have been installed.

The principal dimensions of the ship are as follows:

Keel length	250 feet
Length over all	271 feet 6 inches
Beam, molded	44 feet
Depth to main deck	17 feet
Depth to spar deck	27 feet
Draft aft	12 feet 6 inches
Draft forward	9 feet
Gross tonnage	2,626 tons
Net tonnage	1,684 tons

There are five decks, *viz.*: Orlop, main, spar, promenade and boat decks. The hull is constructed of mild steel, and divided into eight compartments by watertight bulkheads, and the orlop deck is watertight in Nos. 1, 2, 3 and 7 compartments.

The shell plating includes a flat plate keel, 35 inches by 26.25 pounds, and seven strakes amidship on each side. The garboard strake *A* and strake *D* are 22.5 pounds, *B, C, E* and *F* are 20 pounds, and the sheer strake *G* is 30 pounds. The plating between the main and spar decks is 12.5 pounds for the lower strake and 10.2 pounds for the upper. The center vertical keelson is 27 inches by 18.75 pounds, with double 5-inch by 3½-inch by 12-pound angles, top and bottom.

FIG. 2.—STATEROOM DE LUXE ON THE ALABAMA.

the ship for ice work. The bow plating is made of double thickness for the same purpose. The main deck is 15-pound plate, laid flush and covered in the cargo space with 3-inch fir decking.

Supporting the cabin or spar deck are channel belt beams, 12 inches by 25 pounds, spaced 12 feet, and terminating on the belt frames. These beams, in turn, support three I-beam fore and afters. The deck beams are 5-inch by 6.5-pound channels, spaced 3 feet. This deck is laid throughout with No. 10 W. G. plate, to serve as fire protection between the cargo space and the cabins. The 1⅜-inch matched deck is laid on battens on the steel.

The deckhands are berthed on the orlop deck, in the No. 2 compartment, which has asbestos composition floor and steel berths. The No. 3 compartment contains the galley and refrigerators on the starboard side, floored with brick. On the

FIG. 1.—THE GOODRICH TRANSIT COMPANY'S NEW PASSENGER STEAMER ALABAMA.

The frames are 6 inches by 13.75 pounds bulb angles, spaced 24 inches, and running to the main deck. Belt frames of 12-inch by 20.5-pound channels, spaced 12 feet apart, run continuously to the spar deck. The main deck beams are channels, 12 inches by 25 pounds, spaced 4 feet. The orlop decks are all steel, and the beams are exceptionally heavy to stiffen

port side are the mess rooms and rooms for the cook's crew. These rooms are floored with composition. All partitions in the hold are of corrugated iron, with an open space at the top fitted with wire netting screens. The waiters are placed in the No. 7 compartment, with floors and partitions similar to those forward.

The firemen, coalpassers and sailors are housed on the main deck forward, the after partition between the quarters and the cargo space being of steel.

The main deck aft contains the lobby, baggage room, news stand, barber shop, purser's and steward's offices and the men's toilet. The lobby is finished in vermilion wood, with the borders of the panels enriched with inlay, and a marble base board protects the wood work at the bottom. The floor is asbestos composition, with an art border. The purser's and steward's offices are paneled in mahogany and equipped for their purpose; except for the toilet, which is ceiled in birch, all other rooms are finished in white enamel.

The grand staircase leads up the main salon, which is paneled in African mahogany. The panels are particularly large, extending from door to door of staterooms, and are built of beautiful crotch mahogany with inlaid borders on an inlaid figure, showing a conventional design of the cotton plant. The cotton plant, which is associated with the name Alabama, is used throughout the ship as the motif of the design. At the after end of the engine trunk, and directly facing the stairway, is a large panel showing the coat of arms of the State of Alabama, worked in inlay. This appears at a distance as a painting, and only close inspection shows that it is built up of many kinds of wood, each of its natural color.

At each side of the machinery trunk, and leading forward, is a wide passage finished in mahogany and terminating in the dining room. The stateroom numbers throughout are inlaid in the doors and enclosed by a border of the cotton plant.

The dining room extends 38 feet fore and aft and from side to side of the boat, with special rectangular windows, instead of the usual side lights. This room is finished in Prima Vera, an African wood, and is stained a beautiful shade of light green. The panels between the windows and on the other walls as well are inlaid with a spray of the cotton plant. At the after end is an imposing side board, built in, of the same wood, and in each after corner is a private dining room, one finished in cocoa wood, the other in Circassian walnut.

Forward of the dining room is the pantry, officers' mess, and rooms for the forward deck crew. The wireless room opens into the dining room, where messages may be filed and received.

On the promenade deck the entire cabin is given up to state-rooms, which are finished in old ivory enamel and mahogany doors. On this deck there are two public bath rooms, one for men and one for women. The promenade itself is especially wide and can accommodate hundreds of people without crowding.

At the forward end of the boat deck is the large pilot house, with a flying bridge similar to those on ocean liners. The pilot house is placed aft of the foremast, and some distance from the bow. Just aft of the pilot house are the captain's quarters, finished in birch, natural finish. The balance of the forward cabin is devoted to six parlor rooms, with a bath room in connection with each room. These rooms are about 11 feet by 12 feet, and are furnished with brass beds, couches, and dressers, and each suite is decorated differently.

FIG. 3.—FORWARD END OF MAIN SALOON.
FIG. 5.—MAIN DECK.

FIG. 4.—SMOKING ROOM.
FIG. 6.—DINING SALOON.

Aft of the stack are staterooms and rooms for the cabin maids. The after end of the cabin is used for a large buffet, which is finished in Hungarian ash, stained a silver gray, bringing out the beautiful grain of the wood to the best advantage. There are eight alcove seats, with leather upholstering at the sides of the room. Four paintings of woodland scenes are worked into the panels between the windows. The bar is at the forward end, and there are two large refrigerators in connection. Double doors lead from the buffet to an observation deck, where an unobstructed view of half the horizon may be enjoyed.

All of the toilets, bath rooms and crew's rooms throughout the ship are laid with asbestos composition flooring, which is seamless, sanitary and practically impervious to wear. The hallways and buffet are floored with cork tile, which is noiseless. The designing of the cabins was put in the hands of Mr. Abner Crossman, of Chicago, who before retiring was a leading decorator of that city.

The Alabama is equipped throughout with all the latest improved appliances for the safe-guarding of the passengers against fire and the elements, including A-B-C life belts and 12 large metallic lifeboats of the standard Lane and DeGroot type, equipped with Mills releasing gear and operated by Welin quadrant davits. The Alabama is the first boat on the Great Lakes to be equipped entirely with these improved davits. A sprinkler system in all parts of the ship, besides thermostats in every room and elsewhere, augment the regular fire system, which is operated by a large vertical fire pump of the fire boat type. Push buttons and thermostats operate annunciators in the purser's room, engine room and on the bridge.

The steering gear is the Williamson differential type, directly attached to the rudder stock, and the valves are operated by the Williamson telemotor. This steam machine is supplemented by a hand-gear, located on top the upper deck, aft.

The electric plant consists of three 35 kilowatt General Electric Company's turbine generators, operating 1,500 incandescent lamps and a 5,000-candlepower searchlight. There are two freight elevators of the hydraulic type, with platforms 8 feet square.

The propelling machinery consists of one triple expansion engine, with cylinders 23 inches, 38 inches and 62 inches diameter, with a stroke of 36 inches. The wheel is 12 feet in diameter, and has four adjustable blades. The driving shaft is 12½ inches diameter. The engine operates at 120 revolutions per minute, and develops 2,250 horsepower.

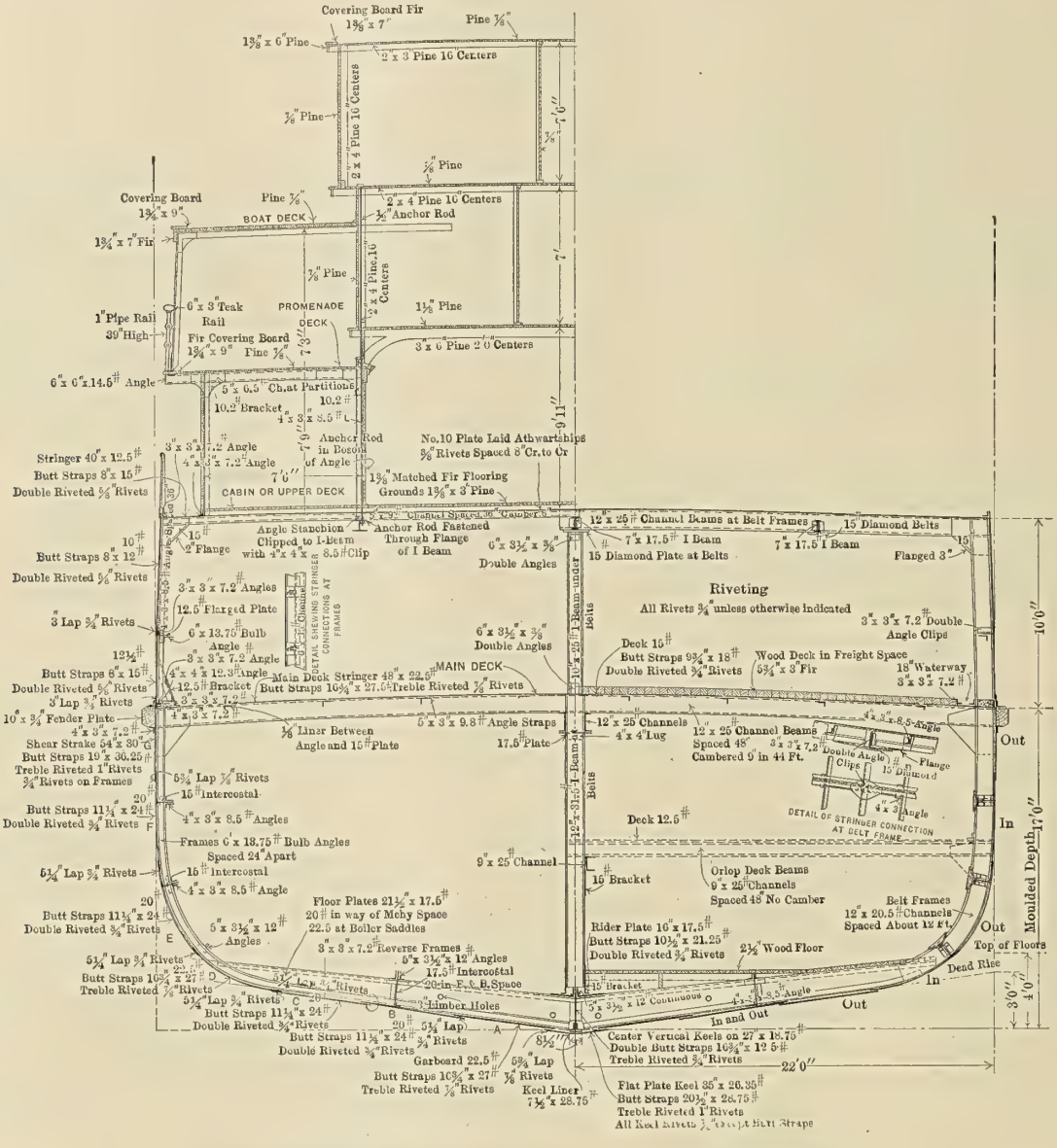

Covering Board Fir 1⅜" x 7"
Pine ⅞"
13⅜" x 6" Pine
2" x 3" Pine 16" Centers
⅞" Pine
2" x 4" Pine 16" Centers
Covering Board 13¾" x 9"
Pine ⅞"
BOAT DECK
½" Anchor Rod
13¾" x 7" Fir
1" Pipe Rail 39" High
6" x 3" Teak Rail
PROMENADE DECK
Fir Covering Board 1¾" x 9"
1⅛" Pine
3" x 6" Pine 2'0" Centers
6" x 6" x 14.5# Angle
5" x 6.5 Ch. at Partitions
10.2# Bracket
4" x 3" x 8.5# ∟
Anchor Rod in Bosom of Angle
No.10 Plate Laid Athwartships
⅝" Rivets Spaced 8" Cr. to Cr
Stringer 40" x 12.5#
Butt Straps 8" x 15#
Double Riveted ⅝" Rivets
3" x 3" x 7.2# Angle
4" x 3½" x 7.2# Angle
CABIN OR UPPER DECK
1⅜" Matched Fir Flooring
Grounds 1⅜" x 3" Pine
Angle Stanchion Clipped to I-Beam with 4" x 4" x 8.5# Clip
Anchor Rod Fastened Through Flange of I Beam
12" x 25# Channel Beams at Belt Frames
15" Diamond Belts
7" x 17.5# I Beam
15 Diamond Plate at Belts
Flanged 3"
Riveting
All Rivets ¾" unless otherwise indicated
Butt Straps 8" x 12#
Double Riveted ⅝" Rivets
3" x 3" x 7.2# Angles
12.5# Flanged Plate
3" Lap ¾" Rivets
6" x 13.75# Bulb Angle
12½#
Butt Straps 8" x 15#
Double Riveted ⅝" Rivets
3" x 3" x 7.2# Angle
4" x 4" x 12.3# Angle
12.5# Bracket
3" Lap ¾" Rivets
10" x ¾" Fender Plate
4" x 3" x 7.2#
Shear Strake 54" x 30" G
Butt Straps 19" x 36.25#
Treble Riveted 1" Rivets
¾" Rivets on Frames
5¾" Lap ⅞" Rivets
15# Intercostal
Butt Straps 11¼" x 24#
Double Riveted ¾" Rivets
4" x 3" x 8.5# Angles
Frames 6" x 13.75# Bulb Angles Spaced 24" Apart
6¼" Lap ¾" Rivets
15# Intercostal
4" x 3" x 8.5# Angle
Butt Straps 11¼" x 24#
Double Riveted ¾" Rivets
5" x 3½" x 12#
Angles
Floor Plates 21½" x 17.5#
20# in way of Mchy Space
22.5 at Boiler Saddles
3" x 3" x 7.2# Reverse Frames
5" x 3½" x 12" Angles
17.5# Intercostal
20-in. F. to F. Space
5¼" Lap ¾" Rivets
Butt Straps 16¾" x 27#
Treble Riveted ⅞" Rivets
Timber Holes
Garboard 22.5#
Butt Straps 16¾" x 27#
Treble Riveted ⅞" Rivets
Keel Liner 7½" x 28.75#
Flat Plate Keel 35" x 26.38#
Butt Straps 20½" x 26.75#
Treble Riveted 1" Rivets
All Keel Rivets 1" except Butt Straps
6" x 3½" x ⅝" Double Angles
Deck 15#
Butt Straps 9¾" x 18#
Double Riveted ¾" Rivets
Wood Deck in Freight Space
6¾" x 3" Fir
18" Waterway
3" x 3" x 7.2#
MAIN DECK
Main Deck Stringer 48" x 22.5#
Butt Straps 16¾" x 27.5#
Treble Riveted ⅞" Rivets
5" x 3" x 9.8# Angle Straps
⅛" Liner Between Angle and 15# Plate
17.5# Plate
12" x 25" Channels
4" x 4" Lug
12" x 25" Channel Beams Spaced 48" Cambered 9" in 44 Ft.
3" x 3" x 7.2# Clips
Double Angle
15" Diamond Flange
4" x 3" Angle
DETAIL OF STRINGER CONNECTION AT BELT FRAME
Deck 12.5#
9" x 25# Channel
15# Bracket
Orlop Deck Beams 9" x 25# Channels Spaced 48" No Camber
Belt Frames 12" x 20.5# Channels Spaced About 12 Ft.
Rider Plate 16" x 17.5#
Butt Straps 10½" x 21.25#
Double Riveted ¾" Rivets
2½" Wood Floor
Top of Floors
Dead Rise
5" x 3½" x 12 Continuous
4" x 3" x 8.5# Angle
In and Out
Center Vertical Keels on 27" x 18.75#
Double Butt Straps 16¾" x 12.5#
Treble Riveted ¾" Rivets
22'0"
Out
In
Moulded Depth 12'0"
10'0"
4'0"
3'0"

FIG. 7.—MIDSHIP SECTION OF THE ALABAMA SHOWING MAIN SCANTLINGS.

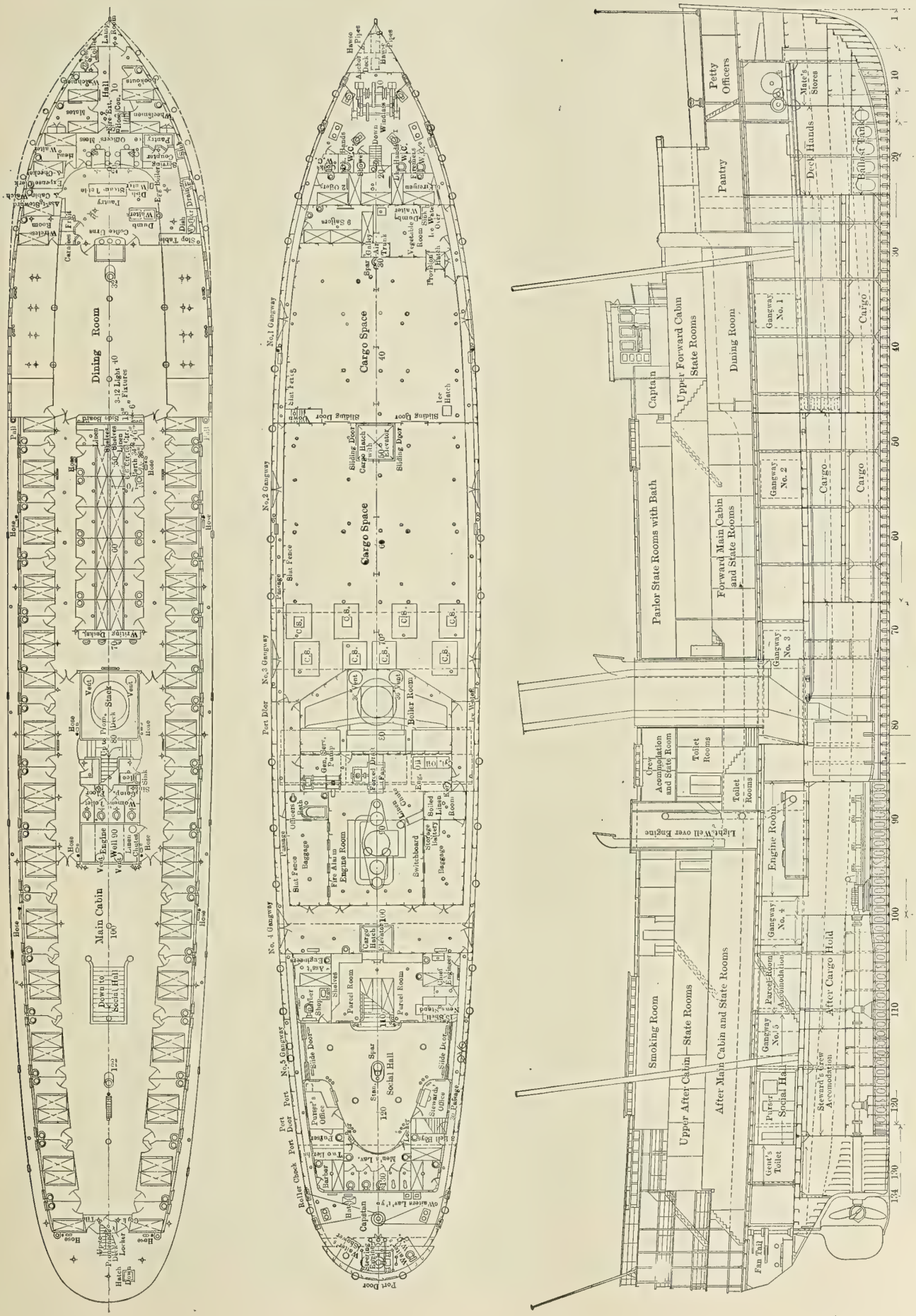


FIG. 8.—INBOARD PROFILE, MAIN AND SPAR DECK PLANS OF THE ALABAMA, SHOWING GENERAL ARRANGEMENT OF PASSENGER AND CARGO ACCOMMODATIONS.

The condensing outfit includes a surface condenser, with an area of 3,000 square feet, a centrifugal pump, with an 8-inch double suction, direct-connected to a 6-inch by 6-inch engine, and a 16-inch by 32-inch Prat Rotrex air pump.

The auxiliaries consist of a feed pump, general service pump, bilge, sanitary and fresh-water pumps, and Ahren's 10-inch by 6-inch by 8-inch vertical fire pump and two 30-inch water filters.

The refrigerating plant is the carbonic anhydride process, and the machine is installed in the engine room and piped to the various refrigerators in all parts of the ship.

The boiler installation consists of a battery of three Scotch marine boilers, 12 feet 6 inches diameter and 11 feet long, carrying 180 pounds of steam. The boilers are placed three abreast across the ship, with a common uptake, and there is a 12-foot firehold and an athwartship coal bunker. Each boiler has two 48-inch Morison furnaces, 286 3-inch tubes, 8 feet and 5/8 inch long. The grate surface is 48 square feet, and the heating surface 2,020 square feet for each boiler. The draft is a modified Howden system, operated by a 48-inch fan, direct-connected to a 7-inch by 7-inch engine, running 400 revolutions per minute. The fan is placed in the engine room on the main deck and tends to make the machinery space very comfortable.

Two 36-inch ventilators lead into the fire room, and, in conjunction with the single row of boilers, cause the firing space to be unusually cool.

Two new steamships, the *Luseric* and *Octeric,* with a combined tonnage of 30,000, have been placed in service by the Waterhouse Line on the route between Puget Sound, Japan, China and Manila, replacing the *Oceano* and *Aymeric.*

COALING WARSHIPS AT SEA.

Naval men, and all persons connected with the merchant marine, who have to handle coal or other bulk cargo in quantities, will find matter of interest in the recent performances of the new United States collier *Vestal* during a recent trip made for attendance upon the battleship *Michigan* and a fleet of destroyers on the coasts of Maine and Massachusetts. The entire fleet of United States colliers is built upon naval designs and equipped with the Spencer-Miller marine transfer, a device for the rapid transfer of coal, which was designed especially for this service and which now gives promise of becoming of considerable interest as an equipment for merchant ships of several classes.

The colliers differ materially one from another in details, but all are alike in the fact that they have large holds adapted to the use of grab buckets for taking out the cargo and hatches suitable for this method of unloading. There are two types of the Spencer-Miller marine transfer installed on them. On the vessels of the *Vulcan* type the booms are swung from king posts placed one on each side of the coal hatch. On the *Vestal* type, the booms are attached to masts, each mast carrying the booms to serve two hatches.

FIG. 1.—COLLIER VESTAL EQUIPPED WITH SPENCER-MILLER MARINE TRANSFERS, COALING A BATTLESHIP.

The *Vulcan* type had its first test in actual service much earlier in the year when the Atlantic fleet was at target practice off Guantanamo, Cuba, and the reports regarding the rapidity with which coal was transferred from collier to warship were most satisfactory. It was shown that the marine transfer would handle coal equally well with the grab bucket or in bags, and that it easily delivered coal to battleships faster than the crew of the battleship could dispose of it. The actual capacity shown in practice, where two trained operators

(Photograph Copyright, 1910, by Enrique Muller.)

FIG. 2.—U. S. COLLIER VESTAL.

transferred 190 tons of coal an hour from a single hatch, was at no time called for, as the crew of the battleships could not dispose of the coal at any such rate. Nearly 1,700 tons of coal was actually put aboard one battleship in five hours using four marine transfer outfits with grab buckets, and one handling coal in bags. This was declared to be a record performance under the circumstances.

The *Vestal* coaled the *Michigan* three times during the recent trip off the coast of Maine. There was no opportunity for testing the continued capacity of the transfer apparatus nor its total capacity, as, on account of experiments which were being conducted, it was necessary to keep the *Michigan* upon a practically constant load line. Therefore only quantities of from 250 to 350 tons were put aboard her each time. These quantities were, however, delivered in record time.

Some of the most interesting operations were in coaling torpedo boat destroyers. These little vessels could take only

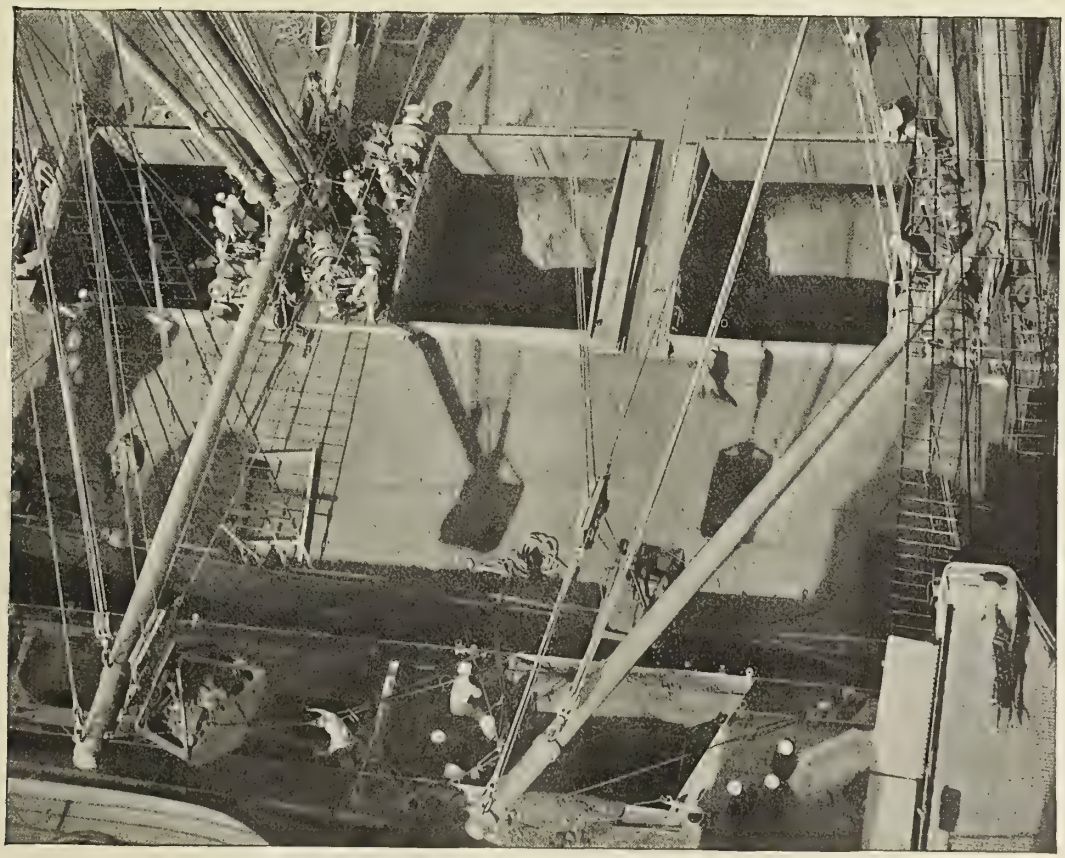


FIG. 3.—BIRD'S EYE VIEW OF THE DECK OF A COLLIER COALING A BATTLESHIP AT SEA.

about 40 tons at a time, but they were provided with a cluster of chutes from the deck to the bunkers, so that they could dispose of the coal rapidly. Notwithstanding their facilities for getting the coal below a single marine transfer with a 1-ton grab bucket was able to deliver the coal faster than it could be disposed of on the destroyers. Torpedo boats were repeatedly coaled with a 40-ton supply in twenty minutes.

These tests indicate very clearly that some modifications will have to be made in the design of modern war vessels, to enable them to dispose rapidly of the coal deposited on deck from colliers when coaling at sea.

THE NEW WHALING BRIG VIOLA.

One of the most notable additions to the American merchant marine this season is the new whaling brigantine *Viola*, recently completed at the shipyard of Messrs. James & Tarr, Essex, Mass. The new vessel is 125 feet long, 26 feet 1 inch wide, and 12 feet ½ inch in depth, the gross tonnage being 190 and carpenter tonnage 307. The frames are of white oak, sided 8 inches and are double, the planking being of the best white oak, 2½ and 3½ inches in thickness, butt fastened with copper spike fasteners. The inner sheathing is of yellow pine, 3 and 4 inches, and the deck is laid with 4-inch white pine, the beams being of oak, 8 inches square. The sheathing on the outside is of copper, three different weights being used, consuming over 4½ tons of copper sheathing and 1,100

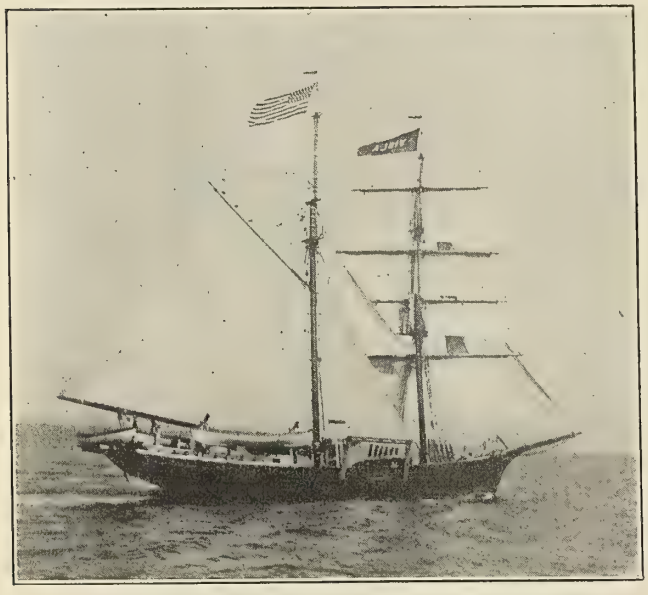


FIG. 1.—THE VIOLA LEAVING PORT ON HER FIRST VOYAGE.

pounds of copper nails; the hull beneath the copper sheathing is covered with felt.

The cabin is handsomely finished in cypress, with a hard pine floor, and is furnished with all modern conveniences, including baths, toilets, hot and cold water, both fresh and salt, etc. A unique feature of the cabin furniture is an ingenious combination sideboard, bureau, desk and medicine chest, making a splendid and useful addition to the cabin equipment. There is also a neatly constructed book cabinet and a sofa, built into the cabin woodwork in such a manner as to be economical of space, yet generous in accommodation. The entire equipment throughout this vessel is a decided innovation compared with the usual type of whaler, and there are many improvements of a radical nature, suggested

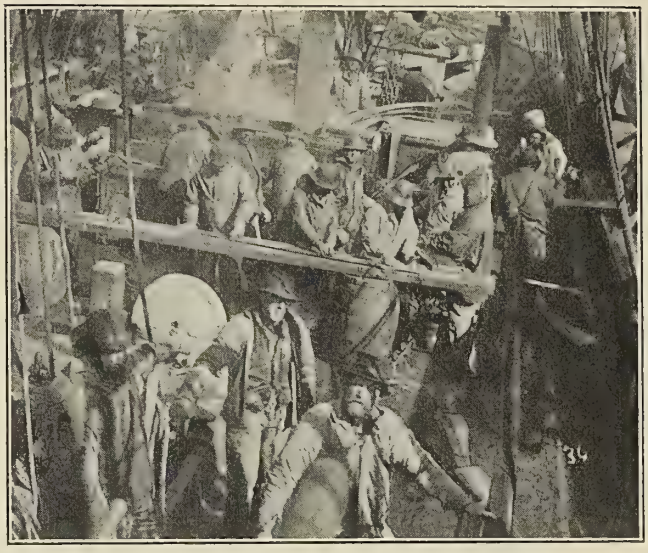


FIG. 2.—DECK SCENE, WASHING WHALE BONE.

by the many years of practical experience of her commander, Capt. John A. Cook, of Provincetown, under whose personal supervision she was built.

The vessel is the property of the John A. Cook Whaling Company, Inc., of Portland, Me., but was fitted out and sails from the old whaling port of New Bedford, Mass., where the entire whaling fleet make their headquarters when in port.

The equipment for whaling includes four whaleboats—three carried on davits in readiness to lower, and one spare boat, carried on the stern. The apparatus for boiling out the oil from the blubber consists of two 165-gallon cast iron trypots, set side by side in a furnace of brickwork, built on deck just aft the foremast, and it is estimated that the vessel can stow about 900 barrels of oil in her hold. Everything about the vessel has had the best of material and workmanship, nothing but selected stock of the finest quality being used, and the work has been done with care and deliberation.

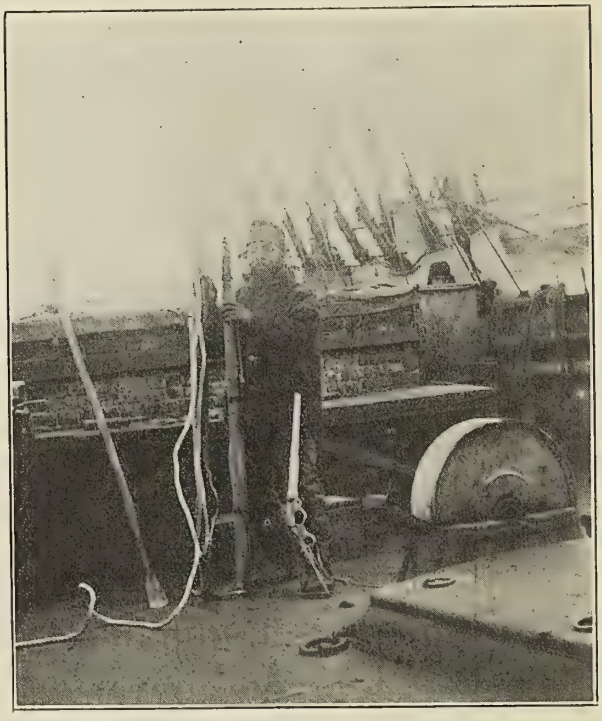


FIG. 3.—SAILOR WITH ALL HIS WHALING GEAR.

The craft conforms to Lloyd's regulations in every respect, and is rated by them A-1 for a period of fifteen years. Completed and ready for sea she is said to represent an outlay of about $45,000 (£9,260).

The accompanying views show the *Viola* as she appeared under sail for the first time, bound on a three years' voyage for sperm whales, and also typical deck scenes on board a whaler. The sail plan here reproduced gives a general idea of the sail area, as well as illustrating the arrangement of the whaleboats on the port side, there being but one carried on davits on the starboard side owing to the method of "cutting in," which is always done from the starboard gangway and cutting stage, which is lowered over the whale secured alongside, amidships. A unique feature of the rig is the introduction of a pole bowsprit, this being the only brigantine ever built so equipped, as far as known.

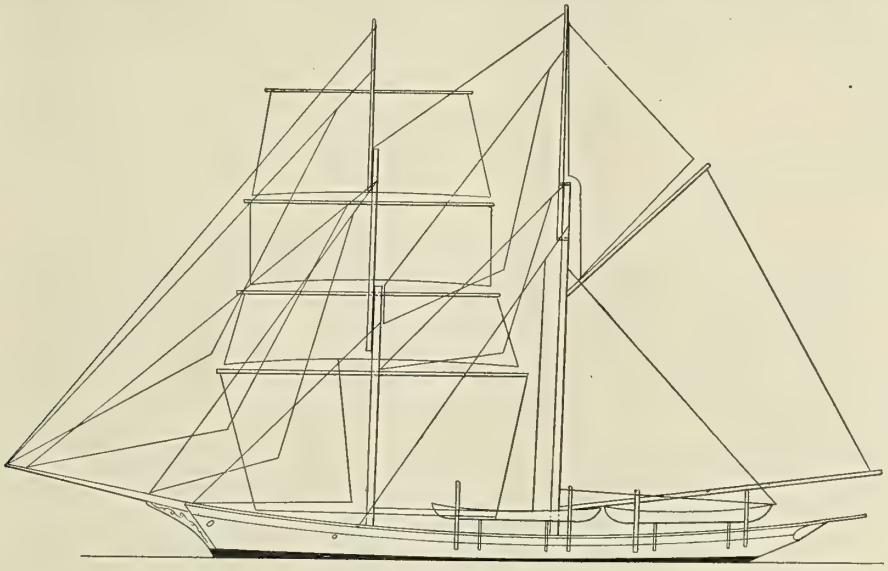


FIG. 4.—SAIL PLAN OF THE VIOLA.

The whaler will carry a crew of twenty-three men all told, including the captain, first, second and third mates. The craft was named *Viola* in honor of the captain's wife, and she has accompanied him on the long voyage as assistant navigator, as she has sailed with him previously for twelve years, and is considered to be an expert navigator.

The Jonathan Holt, Designed for West African Service.

Messrs. William Hamilton & Company, Ltd., Port Glasgow, launched in June, 1910, the *Jonathan Holt*, a handsomely modeled steel screw passenger and cargo steamer, built to the order of Messrs. John Holt & Company, Liverpool. The principal dimensions of the vessel are: Length, 260 feet 6 inches; beam, 38 feet; depth to main deck, 18 feet 3 inches; depth to shelter deck, 26 feet 9 inches.

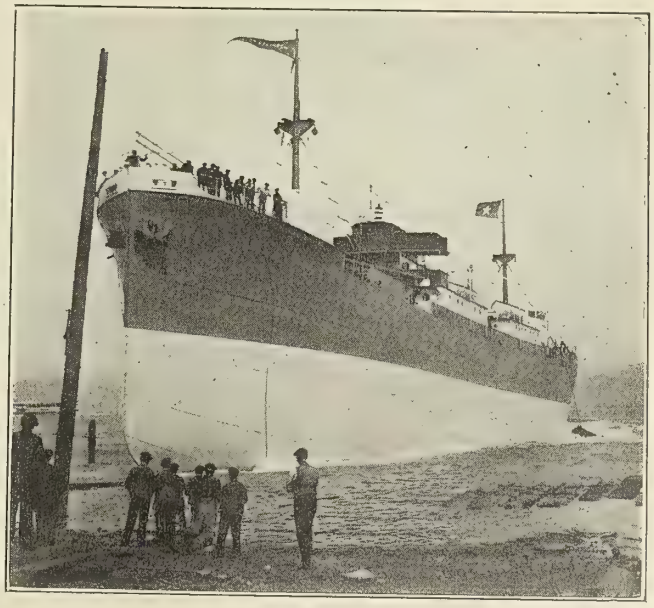
This vessel is intended for the West African trade, and is rigged as a fore and aft schooner; she has a raised forecastle, with accommodation for native "kroo boys," and raised poop with accommodation for the white crew. Accommodation is provided in houses on the shelter deck for the captain, officers, engineers and passengers, and for a handsome saloon, smoking room, etc., etc. Special attention has been given to the ventilation of the vessel, electric fans being introduced. Mosquito screens have been fitted throughout.

The vessel is provided with six large winches, ten large derricks and two extra heavy derricks for special lifts. Electric lights are fitted throughout, and there is a large refrigerating plant with cooling chambers.

The machinery, supplied by Messrs. David Rowan & Company, of Glasgow, consists of triple-expansion engines having cylinders 18 inches, 30 inches and 50 inches diameter by 33 inches stroke, and two single-ended boilers 13 feet diameter by 10 feet 6 inches long, designed for 180 pounds working pressure, natural draft.

The engine cylinders are supported on six columns, the back columns being of cast iron and the front ones of polished wrought iron. The condenser is of the built type, separate from the main structure of the engines, and is arranged with specially large surface for working in tropical waters. The air, circulating, feed and bilge pumps are of the usual reciprocating type, driven by levers off the main engines.

This vessel has been built on the Isherwood system of longitudinal framing, to Lloyd's highest class, special survey,



LAUNCH OF THE JONATHAN HOLT.

and under the superintendence of Messrs. A. C. Hay & Smart, consulting engineers, Liverpool.

A special feature of this vessel is the attempt to make her mosquito-proof in tropical climates. The interior of the vessel is much roomier than the ordinary West African steamer. Every skylight and air aperture on the vessel has special coverings of closely-worked copper gauze. The port holes have double doors—an ordinary glass one for use in the temperate zone and a copper gauze one, which replaces the glass when the tropical zone is reached. There are similar double doors in the saloons of the vessel and in the sleeping quarters of the men.

OLD TRANSATLANTIC PACKET SHIPS.

BY FRANCIS B. C. BRADLEE.

Strange as it may seem to the present generation of travelers, the transatlantic trade some seventy-five years ago was dominated by sailing packets. As early as 1707 there were regular trading ships between Boston and London, some of the best-known captains of that period being Mason, Holberton and Sears. As the eighteenth century wore on Liverpool began to be substituted for London as the English port, the coarser and bulkier cargoes coming from Liverpool and the finer goods being shipped from London. Most of the coarse goods consisted of earthenware, iron ware, coal and salt. In the years just preceding the breaking out of the Revolution the best-known packets between Boston and England were the *Boston Packet,* Captain John Marshall, and the *London Packet,* Captain Robert Calef. Both of these vessels were not over 300 tons register apiece, and both were owned in Boston. During the Revolution and for some time after everything was in such a disorganized condition that, as far as can be traced, there were few regular traders to England.

In 1805 an association was formed in Boston called the Boston Importing Company. The company was to operate vessels, and also import and export goods, between Boston-Liverpool and London. J. W. Storrow was the treasurer of this concern, and Ammidon and Boyle were the agents. In May, 1805, they advertised the ship *Sally,* Captain Seth Webber, "intended for a regular ship between this port and Liverpool, 323 tons, coppered to the bends, and having elegant accommodation for passengers." This vessel and others named the *Packet* and the *Romeo* were run between Boston and Liverpool in 1806 by the Boston Importing Company.

Other regular traders, all American, of this period, to Liverpool, *not controlled* by the Boston Importing Company, were the *President Adams, New-Galen, John Adams, New Packet,* etc.

In addition to the ordinary dangers of the seas American commerce at this time was subjected to great annoyance, disaster and loss, in connection with the tremendous struggle then in progress between Great Britain and France. What with the British orders in council on the one hand and French decrees on the other (it is marvelous that the New England merchants were able to maintain their position on the ocean at all. The Boston Importing Company's ship *Sally* was "sequestered" at San Sebastian in 1810, but finally was released in order to bring home the American Minister to France, Gen. Armstrong. Owing to this and the fact that another of their ships, the *Packet,* had been seized for some time at Hamburg, the Boston Importing Company became involved in financial trouble and its affairs were settled.

The next effort to start a line of packets between America and England was when some New York merchants started the famous Black Ball line to Liverpool in 1816. Each vessel of this line had a large black ball painted on the foretopsail so it could be easily recognized at sea. The Black Ball line of packets was probably the best known of all, for it lasted under different managements until 1883, although it gave up carrying passengers ten years before that. Its last ship was the *Ne Plus Ultra,* of 1,300 tons, Captain Borden.

The first four ships of this line (1816) were the *New York, Canada, Pacific and Jas. Munroe,* each about 400 tons (considered large in those days) and full ship rigged. Their passenger accommodation was considered very fine and caused the old merchantmen to seem shabby and uninhabitable. These vessels sailed from either side regularly on the 1st of each month, and for the first nine years their average passage to the eastward was 23 days and westward 40 days, although the *Canada* once made the eastward passage in 15 days 18 hours.

NEW YORK AND LIVERPOOL PACKET SHIP ROSCIUS OF THE DRAMATIC LINE (1835).

BURNING OF THE WHITE DIAMOND LINE PACKET OCEAN MONARCH JUST OUTSIDE LIVERPOOL, AUGUST 24, 1848.

The Black Ball line gradually increased its sailings and vessels adding such ships as the *Oxford, Cambridge, Yorkshire, Devonshire, Independence* (which although built as far back as 1834, once made a voyage to Liverpool in 13 days) *Isaac Webb* and many others. The *Isaac Webb* was perhaps one of the best known of their vessels. She was built by Wm. H. Webb at New York in 1850 of live oak, locust and cedar, 188 feet long, 40 feet beam, and 28 feet depth, with three full decks and a registered tonnage of 1,300. She often made the voyage to Liverpool in 16 and 17 days.

In 1821 Byrnes, Grimble & Co. started another Liverpool line called the Red Star, with ships called the *Panther, Hercules,* etc., and which sailed on the 24th of each month. Then followed the Swallow Tail line, with the *George Washington, Pennsylvania,* etc., and in 1836 Mr. E. K. Collins founded what was known as the Dramatic line, the ships of this line being named after celebrated actors, as the *Roscius, Siddons, Garrick* and *Shakespeare.* These vessels were considered very large for their day, being 1,000 tons or more each. A noted departure also in these ships besides their superior interior fittings was the total abandonment of the fine lined vessel having a sharp rise of floor and the substitution for it (against the opinion of the noted New York shipbuilders) of the flat floored form of hull. Mr. Collins afterwards founded the famous Collins line of steamers between New York and Liverpool in 1850, but it was unsuccessful.

THE MORGAN LINE PACKET SHIP VICTORIA (1843).

Other well-known lines of packets were Morgan's to London; Grinnell & Minturn's to London and Liverpool, owning the *Constitution, Cornelius Grinnell, etc.;* Williams & Guion's Black Star line to Liverpool, all from New York.

The *Adelaide* of the Black Star line in 1864, while on her way down New York harbor, was passed by the steamer *Sidon* of the Cunard line, but the *Adelaide* arrived in the Mersey before the *Sidon,* having made the passage in 12 days 8 hours.

THE SOUTHAMPTON OF THE MORGAN LINE (1849).

In 1866 Messrs. Williams & Guion, finding it impossible to compete against steamships, built a line of steamers known as the Guion, but owing to the stringency of the United States laws, this line was operated under the English flag, although it was really entirely owned by American capital. The Guion line of steamers has been extinct only since 1894.

All of the packet ships belonging to the various lines were not, contrary to general opinion, of the "clipper" type, with the exception of the *Dreadnought, Racer* and a few others to be noticed later, the clippers being almost always built for the China, India and San Francisco trades. The packet ships were built with more or less round bows, full poops extending nearly to the mainmast, and great breadth of beam, thus insuring large carrying capacity combined with strength of hull. They were not intended for extreme speed, and when they did make rapid passages it was entirely owing to the good seamanship of the commanders in being able to carry a heavy press of canvas.

THE ISAAC WEBB (1851) OF THE FAMOUS BLACK BALL LINE.

The packets conveyed higher grade cargoes, also cabin and steerage passengers. The former, with the captain and officers, were lodged under the poop, and although the cabins and saloon (or cuddy, as it used to be called) were then considered very fine and spacious, they would not compare with modern standards. Each ship had room for from 10 to 20 saloon and 500 to 1,000 steerage passengers, and these latter

were berthed in the 'tween decks. There was no ventilation, and in bad weather the steerage passengers would be driven below and the hatches would be clapped down upon them. Conditions then may better be imagined than described.

Steerage passengers had to provide their own bedding and do their own cooking, and the following was the bill of fare legally instituted for them by the British Government: Each adult to receive weekly as follows: 3½ pounds bread or biscuit not inferior in quality to navy biscuit; 1 pound flour, 1½ pounds oatmeal, 1½ pounds rice, 1½ pounds peas, 1¼ pounds beef, 1 pound pork, 2 pounds potatoes, 2 ounces tea, 1 pound sugar, ½ ounce mustard, ¼ ounce ground black pepper, 2 ounces salt, 1 gill vinegar.

Cabin passengers fared somewhat better, as may be seen by the following dinner bill of fare on board the *Cornelius Grinnell* on her way from New York to London in 1858: Soup, boiled cod with boiled potatoes, roast turkey, mashed turnips, roast and boiled potatoes, stewed chicken with macaroni, pie, hot rolls, sea pies and pickles, plum pudding.

The rates of passage varied, but the following may be taken as the average: Saloon, $150 (£31), and steerage from $25 to $40 (£5 to £8).

Probably the best known of the transatlantic packet ships was the celebrated *Dreadnought,* commanded by the equally celebrated Captain Samuel Samuels. The *Dreadnought* was built at Newburyport, Mass., in 1853, and was of 1,400 tons register. She was what might be termed a semi-clipper, and as Captain Samuels says in his book "From the Forecastle to the Cabin," possessed the merit to bear driving as long as her sails and spars would stand. Twice she carried the latest news to Europe, slipping in between the steamers. Her cabin accommodation was generally engaged a season in advance, and freight by her was guaranteed to be delivered within a certain time or freight charges forfeited. The *Dreadnought* was built for the Red Cross line of packets, to run in conjunction with the *Racer, Driver, Highflyer* and *St. Patrick,* but, strange to say, every one of these vessels was lost through one cause or another, leaving the *Dreadnought* all alone on the line. She made the passage from Liverpool to New York, dock to dock, in December, 1854, in 13 days, 11 hours, and in 1860 she capped the climax and reached Queenstown in 9 days and 17 hours from New York, a feat never equalled before or since by any sailing vessel.

Captain Samuels always attributed his fast passages to good discipline and forcing the ship at night as well as during the day. Of course, all voyages were not always fast. In the winter and spring, owing to the prevalence of westerly gales, it was not uncommon for the packet ships to be 50, 60, or even 70 days in reaching New York. The *Switzerland,* of Grinnell's line, was once 110 days on the voyage.

The crews of the transatlantic packets (or "packet rats," as they were called), were never noted for tender qualities. Captain Samuels says of them: "They were the toughest class of men in all respects, and could stand the worst weather, food and usage, and put up with less sleep, more rum and harder knocks than any other sailors. They would not sail in any other trade." In August, 1859, the *Dreadnought* was the scene of a serious mutiny and the ship had to be worked for several days by Captain Samuels and his officers alone, but at last the crew was overawed by stern measures and loaded firearms.

CLIPPER SHIP DREADNOUGHT (1854) OF THE RED CROSS LINE OFF TUSKAN LIGHT.

In February, 1862, the *Dreadnought,* while on her way to New York, encountered a severe gale, lost her rudder, and Captain Samuels broke his leg. For several days the ship lay in the trough of the sea quite unmanageable. They were 600 miles from Fayal, and being unable to keep the ship's head to the sea, Captain Samuels managed to back her 280 miles. In the meantime a jury rudder was rigged and the vessel finally arrived safely at Fayal, where she remained several months.

The *Dreadnought* was finally forced out of the transatlantic trade by the steamers and ran for some years between New York and San Francisco; she was totally wrecked near San Francisco in 1869. Captain Samuels occupied a number of responsible positions ashore for a number of years, and finally died in Brooklyn in May, 1908, aged nearly 90.

In 1821 the Boston and Liverpool Packet Company was organized in Boston. They tried to get a charter from the Legislature and failed, but nevertheless ran several ships, including the *Amethyst, Topaz* and *Sapphire,* between Boston and Liverpool, but the enterprise soon failed. Very little can be found out about it.

In 1827 another Liverpool packet line was organized in

Boston by Henry Hall, Joshua Blake, David Henshaw and others. They also tried to get a charter from the Legislature, but failed. Nevertheless, they had built for them at Medford, by Thatcher Magoun, several ships of the highest class—the *New England, Lowell, Trenton, Plymouth, Boston* and the *Liverpool*—all between 400 and 500 tons. Jabez Howes was the best-known captain on the line, and Geo. G. Jones was the agent, and, according to the advertisement, "mattresses, bedding, wines and all other stores were to be furnished to passengers in the cabin, and for them the fare to Liverpool was to be $140 (£29). The packet *Boston* belonging to this line was struck by lightning and burnt May 26, 1830, a few days out from Charleston, S. C., on her way to Liverpool. Sir Isaac Coffin, the Boston boy who rose to the position of admiral in the British Navy, was a passenger. This packet line ceased operations (probably owing to hard times) about 1833, as no trace of it can be found after that date.

The first line of packets to Havre from New York was started in 1822 by Francis Depan with ships named the *Stephania,* Captain John B. Pell; *Henry IV.,* Captain Wm. W. Skiddy, and *Helen Mar,* Captain Harrison. Other lines to Havre were started in 1823 by John J. Boyd, and in 1832 by Wm. Whitlock, Jr.

In 1844 Mr. Enoch Train started his *celebrated and by far the best known* line of Boston and Liverpool packet ships. The first ships advertised by the new line were the *Dorchester,* 500 tons; the *Cairo,* 600 tons; the *Governor Davis,* 800 tons, and the St. Petersburg, 800 tons, "all first class Medford-built, copper-fastened, coppered and fast-sailing ships." Mr. Train afterward added to his fleet the following vessels: *Joshua Bates, Anglo-Saxon, Anglo-American, Washington Irving, Ocean Monarch, Parliament, Daniel Webster, Star of Empire, Chariot of Fame, Staffordshire, Cathedral* and the *John Eliot Thayer.* All these latter ships were built by the celebrated Donald McKay at East Boston, and were large for their day, ranging from 1,000 to 1,500 tons each. They were especially designed for the emigrant trade.

The *Ocean Monarch* of this line met with a very sad fate. She left Liverpool for Boston August 24, 1848, under command of Captain James Murdock, with 32 cabin, 322 steerage passengers and a crew of 42 on board. Soon after the tug had left her outside Liverpool she was discovered to be on fire, owing, it is said, to one of the steerage passengers lighting a fire in a ventilator. As she had just left port, more or less confusion prevailed and part of the crew were drunk. According to Captain Murdock's own account, "We began without delay to throw water down, but five minutes afterwards—indeed almost instantly—the after part of the ship burst into flames. We put the ship before the wind in order to lessen the draft, but were obliged to bring her to again. The fire produced the utmost confusion among the passengers, desperation prevailed, yells and screams of the most horrifying description were uttered, all control over them was lost; my voice could not be heard, nor my orders obeyed."

To make a long story short, the *Ocean Monarch* burnt so rapidly that in spite of several ships being near at hand and sending assistance at once (among which may be mentioned the new Brazilian frigate *Alfonso,* which was on her trial trip with the Prince de Joinville, son of the ex-King of France, Louis Phillipe on board), 178 persons lost their lives either by burning or drowning. At a court of inquiry Captain Murdock was exonerated from all blame.

The sketch of the burning ship (page 375) is from the sketch book of the Prince de Joinville himself.

Probably the best known of all Train's ships was the *Staffordshire,* built by Donald McKay in 1851. She was 240 feet long, 41 feet beam, 37 feet depth, and registered nearly 2,000 tons. She was full clipper type and very fast. She was lost on the Nova Scotia coast December 30, 1853.

The *Staffordshire* was commanded by Captain Josiah Richardson, and when the ship went ashore he said: "My passengers first, my crew next, and then my officers, and I will stay by my ship," and he went down with her. Captain Richardson was a native of Shrewsbury, Mass., and there is a monument erected to his memory in the beautiful cemetery of that town.

Other well-known captains in the "White Diamond" line, as Mr. Train's line was called, were: Caldwell, Thayer, Brown, Howard and Knowles. The present Warren line of steamers, although sailing under the English flag, is the outcome of the Train line of packet ships. After Mr. Train died the firm became Thayer & Warren, and then Warren & Co.

Another well-known "White Diamond" packet was the *Daniel Webster,* built in 1850 to replace the *Ocean Monarch.* She was built by Donald McKay at East Boston, in the strongest and best manner of white and live oak, at a cost of $80,000 (£16,500), 1,500 tons register, 186 feet long, 40 feet beam. She had a full poop extending nearly to the mainmast, under which was the saloon and first-class cabins. The saloon was described as a "spacious apartment, fitted elegantly in rich, deep-veined mahogany, with columns relieved with gold. The ceiling is white and gold." The emigrants' quarters were a great improvement over anything then existing, being fitted up with iron berths and two hospitals, the latter a great novelty.

The captain of a packet was a much more important personage than a Cunard captain is to-day. He was an owner as well as a commander, and he met the shipping merchants on terms of social equality. He was absolute master of his vessel and of every man on board of her. His income was often $5,000 (£1,030) a year, consisting of 5 percent of all the freight money, 5 percent of all steerage passage money, 25 percent of all cabin passage money, the entire receipts for carrying the mails (2 pence a letter from the British Government and 2 cents a letter from the American Government), and a salary of $360 (£74) per annum. Moreover, he had the privilege of taking his wife, and sometimes even her sister aboard free. A packet captain also attended personally to the lading, rigging, victualling, manning and many other details of a ship's orderly departure, superintending and paying for repairs and keeping a regular business account with the agents as one merchant does with another.

For a time after the steamers started the packets held their own, but the introduction of iron, screw-propelled steamers carrying freight and emigrants at reduced rates sounded their death knell, and by 1875 few were left, and these had given up carrying passengers. The Black Ball line in 1847 placed a steamship in service, the *United States,* built by Wm. H. Webb at New York. She was a large, wooden side-wheel boat of nearly 2,000 tons, but soon after she came out the company accepted a tempting offer for her from the Prussian Government, and she was made into a steam frigate.

It is rather a painful contrast to present American deep water shipping conditions, to think that previous to the introduction of steamers in the transatlantic trade (1838) the United States controlled nearly the whole of this vast traffic. With the exception of the Hamburg-American line of German packets, now the Hamburg-American line of steamers, *every line of packets* was under *the American Flag.* To-day there are *four* American transatlantic steamers, and, of course, no sailing vessels at all. *There was not a single line of English packet ships,* whereas to-day Great Britain stands supreme in the deep sea carrying trade.

Lieutenant Commander Roscoe C. Moody and Lieutenant Commander Milton E. Reed have been detailed for permanent duty as designing engineers in the Bureau of Steam Engineering, United States Navy.

THE MARINE STEAM ENGINE INDICATOR—XIV.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

THE DIAGRAM.

In the preceding chapters an attempt has been made to describe the indicator, to point out the most widely differing details of the various designs, to describe methods of testing and keeping the instrument and its reducing gear in order and to give directions for the proper manipulation of the mechanisms when taking diagrams. It now remains to show just what the diagram is, what may be deduced from it and the most common errors to which it is liable. Very few have sufficient comprehension to gather any clear idea of the relation between two or more variable quantities when these quantities are represented by figures only, and to make such relations clearer mathematicians have long made use of graphic diagrams, certain forms of which will now be described.

A thorough understanding of simple graphic diagrams is a necessity for every marine engineer who would advance in the theoretical part of his profession, because the technical press contains an ever-increasing number of them, and in indicator work a knowledge of simple graphics is absolutely essential. The reader is therefore urged to make a few of these diagrams for himself, using any tables which he may have at hand and which contain two sets of variable quantities.

The system about to be described was originated by Descartes in 1637, and hence is called the *Cartesian System* in

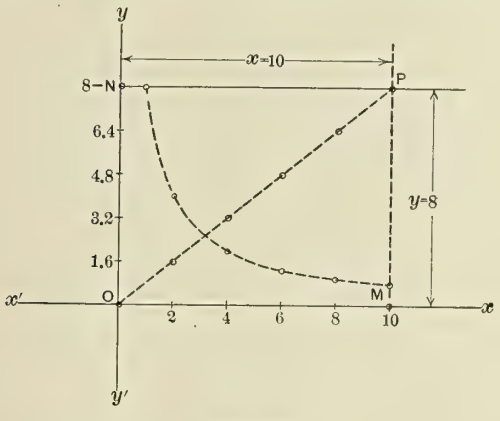


FIG. 93.

honor of its inventor, and the simple forms here shown are the starting point of *co-ordinate* or *analytic geometry*.

Upon a sheet of paper draw a horizontal line $x'x$, and intersecting it at right angles at the point O a straight vertical line, $y'y$, as in Fig. 93. The line $x'x$ is known as the *Axis of Abscissæ*, or *Axis of X*, and the line $y'y$ as the *Axis of Ordinates*, or *Axis of Y*. The point O in which the lines intersect is called the *Origin*. The two lines when spoken of together are called *Co-ordinate Axes*, and the term rectangular is sometimes prefixed because the axes are at right angles. If through the point P we draw PM parallel to $y'y$, and PN parallel to $x'x$, it is at once plain that the position P is known if the lengths PM and PN are known; that is to say, when the value of its co-ordinates are known. Distances measured on or parallel to $x'x$ are usually referred to as the distance X and distances measured on or parallel to $y'y$ as the distance Y. Suppose that P is 10 inches to the right of the axis of Y and 8 inches above the axis of X. The *Equations of the Point* are $x = 10$ and $y = 8$. The distance 10 is also known as the absicssa of the point P and the distance 8 as the ordinate.

The equations for the point N are $y = 8$, $x = O$, and for the point M, $x = 10$, $y = O$.

Draw a line from O to P. The *equation of the line is*, $y = .8x$. Assign any value to x, as 2, 4, 6, 8, 10, as shown in the figure. Mutliply these numbers by .8 and we get the following results for values of y:

When X is	2	4	6	8	10
Y is	1.6	3.2	4.8	6.4	8.0

Locate the points whose equation are $x = 2$, $y = 1.6$; $x = 4$, $y = 3.2$. A straight line will pass through the origin, the points located from the equations, and the point P. The reader should verify this statement by constructing the diagram. This line is technically known as a curve, no matter what its form.

[1] Take the equation $x\ y = 8$. To trace this curve divide both sides of the equation by x and we have the equation in the form $y = \frac{8}{x}$. Let $x = 1, 2, 4, 6$, as before and solve to determine a set of values for y as given below:

When X is	1	2	4	6	8	10
Y is	$\frac{8}{1}$ or 8	$\frac{8}{2}$ or 4	$\frac{8}{4}$ or 2	$\frac{8}{6}$ or 1.3	$\frac{8}{8}$ or 1	$\frac{8}{10}$ or .8

Locate the points and draw the curve. This curve is a rectangular hyperbola and is much used in the analysis of indicator diagrams.

Before taking up the indicator diagram two examples of the practical use of graphic diagrams will be given, this in order to show the very clear manner in which more or less obscure relations between variables are indicated. Consider the following quantities taken from the steam tables of Marks and Davis[2] showing the relation between the pressure and temperature of saturated steam:

Absolute Pressure Lbs. per Square Inch Also Values of x.	Temperature Degrees Fahr. Also Values of y.	Absolute Pressure Lbs. per Square Inch Also Values of x.	Temperature Degrees Fahr. Also Values of v.
20	228	120	341.3
40	267.3	140	353.1
60	292.7	160	363.6
80	312.	180	373.1
100	327.8	200	381.9

An inspection of the above table will enable us, at best, to obtain only a hazy idea of the relation which exists between the columns of variable quantities. To make the relation clearer lay down a graphic diagram as follows:

Every engineer should have on hand a few sheets of co-ordinate paper, ruled 10 x 10 to the half inch, with every tenth line in both directions a little heavier than the rest, as shown in Fig. 94.[3] Let each single division horizontally represent one pound pressure above absolute vacuum and mark every ten pounds with figures along the axis of X. Let each vertical division be one degree Fahrenheit (commencing at the axis of X with 100 degrees) and mark every ten degrees with figures along the axis of Y. Locate the point $x = 20$, $y = 228$, as shown at 1 in the figure, then $x = 30$, $y = 267.3$, as at 2. Fix the remaining points given in the table, as shown at 3, 4, 5, 6, 7, 8, 9 and 10, and pass a smooth curve through them. An inspection of the curve shows that the slope is about 45 degrees between 60 and 80 pounds absolute, and in consequence that the temperature increases about one degree for each pound increase in pressure. That between 20 and 30 the increase in temperature is about two degrees for every pound increase in pressure, and between 160 and 180 pounds the increase is only one-half degree per pound. No simple equation which will satisfy this curve is known to the writer.

It will be noticed that pressures and temperatures intermediate to those used in laying out the curve can be readily

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[1] The reading of this paragraph may be omitted if the solution and the equations is not clear to the reader.

[2] Tables and Diagrams of the Thermal Properties of Saturated and Superheated Steam. Longmans, Green & Co., 1909.

[3] This paper is usually known as "Cross Section" paper in the United States and "Squared" paper in Great Britain. Sheets of the best quality with the outside dimensions of the ruling about 5 inches by 7-¼ inches can be obtained for 25 cents (1 shilling) per quire.

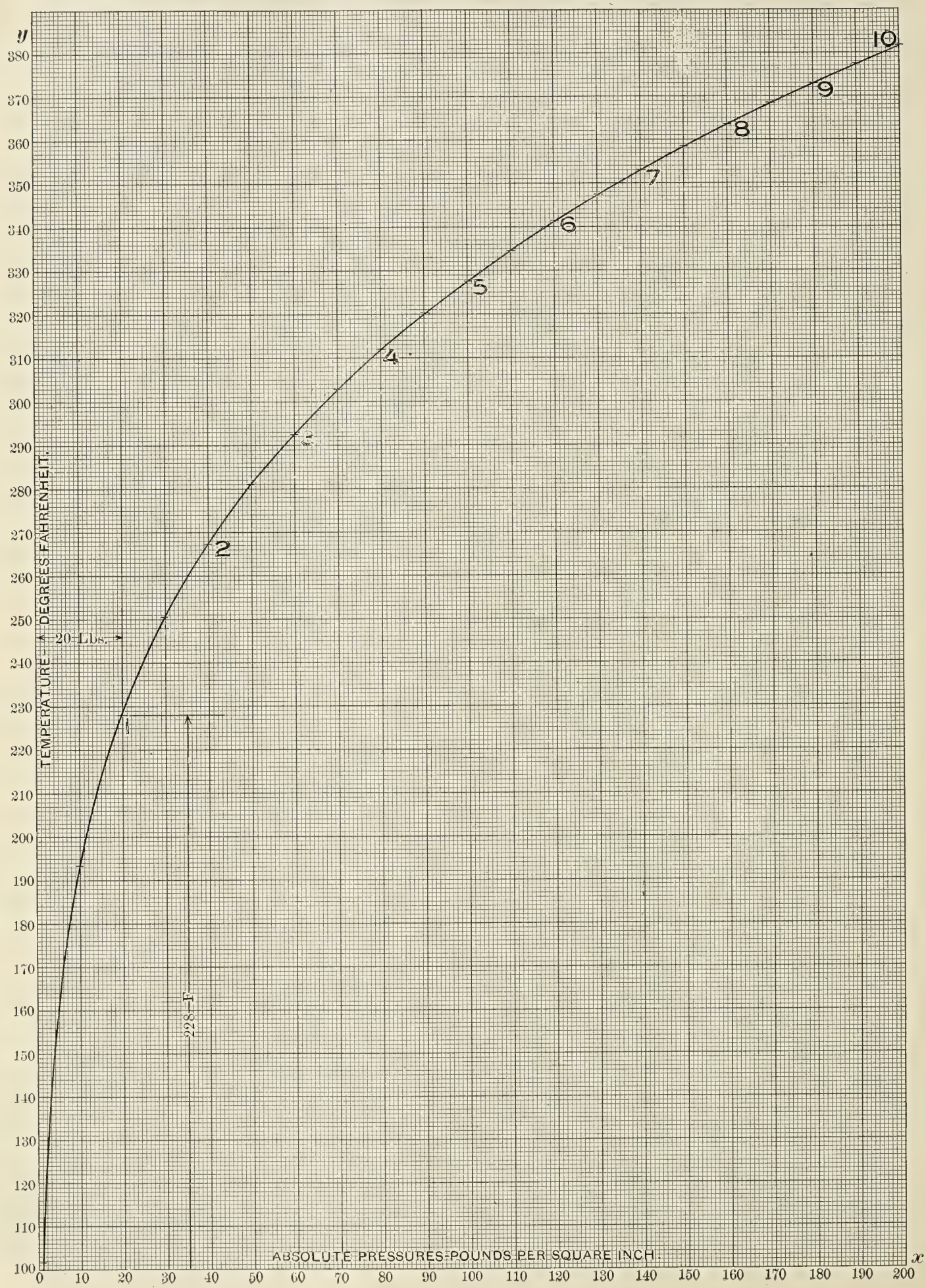

y
TEMPERATURE ← DEGREES FAHRENHEIT.
20 Lbs.
228 F
1
2
3
4
5
6
7
8
9
10
ABSOLUTE PRESSURES-POUNDS PER SQUARE INCH
x

FIG. 94.

taken from the diagram and this with a close degree of accuracy. If the curve had been run through points located by actual observation during a test of pressure and temperature, and any point had fallen much outside of the smooth curve, attention would at once have been called to the discrepancy, and the observation either thrown out or re-verified. This is another advantage of a graphic log.

Graphic diagrams are frequently made use of by marine engineers for displacement curves; speed and horsepower; speed and revolutions; speed and coal consumption; mean effective pressure; revolutions and horsepower, etc. etc.

In order to illustrate the action of the steam in an engine cylinder let us suppose that we have a condensing engine as follows: Stroke, 50 inches; steam admission cut-off at 15 inches on the down stroke; the exhaust opening at 48 inches. On the up-stroke the exhaust is closed when the piston is 3 inches from the top, and the lead is such that steam is again admitted when the piston is ½ inch from the top. The pressure in the valve chest is 30 pounds above absolute vacuum, and the vacuum gage attached to the condenser reads 26 inches, corresponding to 2 pounds absolute pressure. For the sake of simplicity suppose the engine to be without clearance. The cylinder diameter is omitted, as it does not concern us at present.

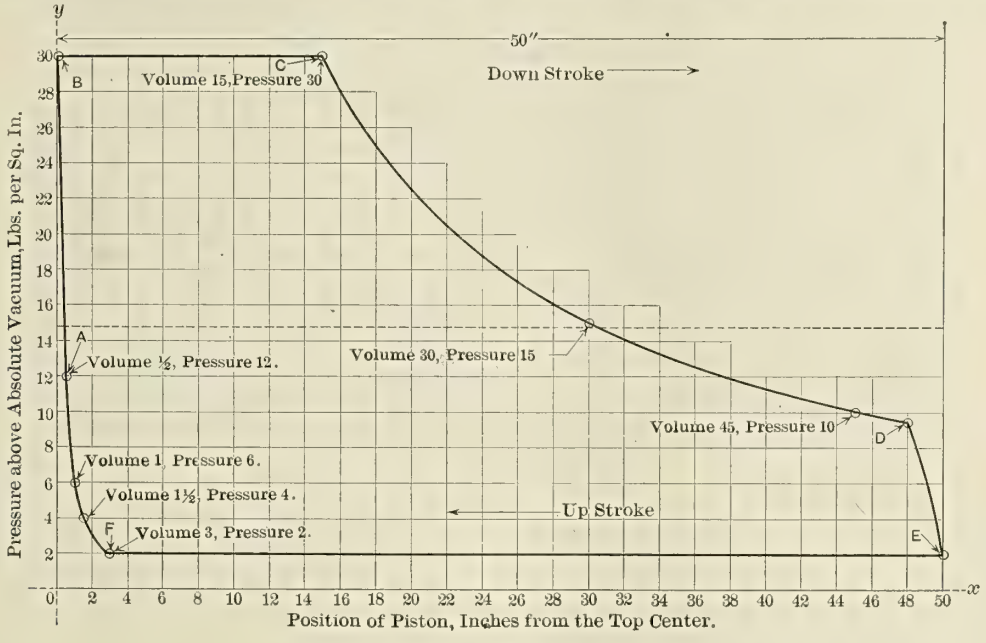


FIG. 95.

Let the axis of X (Fig. 95) represent zero pressure, and the axis of Y zero volume, the top of the piston being against this latter line when the engine is on the top center. Let us suppose that the piston on its up-stroke has reached the point $x = ½$; the steam valve opens, and by the time the piston has reached the top center ($x = O$) the steam pressure has run up to equal that in the valve chest, or 30 pounds ($y = 30$). Mark the point $x = O$, $y = 30$, as shown at B. The piston now commences its downward stroke, represented on the diagram by motion from left to right. The steam valve is open and the pressure remains equal to that in the valve chest. When the piston has moved downward 15 inches the admission of steam is suddenly stopped. This point is indicated at C ($x = 15$, $y = 30$). As the steam supply is cut off, and the piston still going down, the pressure falls proportionately as the volume increases, the graphic representation of the combined pressure and volume being approximately a portion of an hyperbola. Observe that the pressure multiplied by the volume at the point C is 15 x 30, or 450, which gives us as an equation for this hyperbola $x \times y = 450$. By dividing this constant number by the value of x (the completed stroke at any point) we obtain the value of y (the pressure) at the corresponding point. At the point $x = 30$ the volume is twice as great as at C, and the pressure one-half, or 15 pounds. At 45 inches the volume is three times as great and the pressure one-third, or 10 pounds. At the point D ($x = 48$, $y = 9.37$) the valve opens to exhaust, and the pressure above the piston falls rapidly towards condenser pressure. By the time the crank pin crosses the bottom center the pressure has dropped to that of the condenser at E ($x = 50$, $y = 2$). The up-stroke begins here, represented on the diagram by motion from right to left, with the pressure equal to that in the condenser. When the piston has completed 47 inches of its upward stroke, and is within 3 inches of the top, the exhaust port is closed, as indicated at F ($x = 4$, $y = 2$). The rising piston compresses the imprisoned steam, and the pressure runs up as shown in the figure. At A ($x = ½$, $y = 12$) the valve opens to steam and the cycle is complete. Notice that at F the volume is 3 and the pressure 2, and the product of the volume times the pressure is 6 ($x \times y = 6$). To find the pressure at any other point divide the constant 6 by the volume x. Thus at $x = 2$ the pressure is 3, at $x = 1$ the pressure is 6, and at $x = ½$, the point at which the valve opens to steam the pressure has risen to 12 pounds.

To go over the cycle again: A is the *point of admission; AB* the *admission line; BC* the *steam line; C* the *point of cut-off; CD* the *expansion line*, or *expansion curve; D* the *point of release; DE* the *exhaust line; EF* the *counter-pressure* or *back-pressure line; F* the *point of compression* or *point of exhaust closure*, and *FA* the *compression line* or *compression curve.*

If instead of steam the engine were moved by a perfect gas, acting in a cylinder and against a piston made of non-conducting material, and in addition if the valves opened and closed instantly, the ports being so large that there was no friction and the engine was without clearance, the diagram of Fig. 95 would be drawn by a perfect indicator.

The actual diagram, as drawn by the instrument, will vary from the theoretical to a greater or less degree at every line and point, and the extent of this variation is the basis of diagram analysis. From a diagram carefully and properly made by correct instruments we can determine the sufficiency of

the steam pipes, steam ports and passages for admission and exhaust; the adequacy of the valve gear relative to the time of the admission, cut-off, release and compression, and whether or not the valves move as rapidly as they should during opening and closing. The percentage of vacuum realized in the low-pressure cylinder is shown, and taken in connection with other data the power exerted on the piston can be computed and the consumption of steam closely estimated.

In connection with the diagrams certain *reference lines* are used and are defined as follows:

The *zero line of pressure,* or line of absolute vacuum, is the axis of *X* in Fig. 95, and represents a perfect vacuum or absence of all pressure. It is located by scale from the atmospheric line drawn by the indicator.

The *atmospheric line* is 14 7/10 pounds above the zero line of pressure with the barometer standing at 29.92 inches. It is indicated in Fig. 95 by the broken line at the proper height above the axis of *X*. The *vacuum line* is parallel to the atmospheric line and a distance below it equal to the vacuum indicated by the condenser gage.

The *line of boiler pressure,* or *line of receiver pressure,* is a line drawn parallel to the atmospheric line located by scale measurement at a distance above it equal to the reading of a pressure gage attached to the boiler or space from which the engine takes steam. On cards from intermediate and low-pressure cylinders this line shows the average receiver pressure.

The *clearance line,* or line of zero volume, is the axis of *Y* in Fig. 95. This engine was supposed to be without clearance. If the clearance had been 10 percent the axis of *Y* would have been 10 percent of 50, or 5 points farther to the left of that shown in the figure. Note that clearance is of two kinds —*linear clearance,* which means the distance in linear measure between the piston and cylinder top or bottom when the engine is on the center, and *volumetric clearance,* meaning the total *volume,* in cubic measure, between the piston and cylinder ends, plus the ports and passages, clear to the valve. In indicator work volumetric clearance is always understood unless otherwise noted.

(To be continued.)

The new United States oil-burning destroyer Paulding, recently completed by the Bath Iron Works, Bath, Me., averaged 33.07 knots for five runs over the Owl's Head course on her standardization trials.

Repairs to the J. T. Morse.

The steamef *J. T. Morse,* of the Eastern Steamship Company, running between Rockland and Bar Harbor, Me., built by William McKie, at East Boston in 1904, was sunk recently at her dock by the turbine steamer *Belfast,* owned by the same company. After being floated the *Morse* was towed to Camden, Me., and hauled out on a railway and temporarily patched, the repairs being sufficient to enable her to proceed to Boston. She arrived at Boston under her own steam, where she was hauled out and found to have a hole 20 feet long, cut through to her keelsons. This required six new frames on her starboard side, twenty-four streaks of plank and ceiling, new keelsons and a complete calking. All her lower joiner work was removed and replaced by new work, and the carpets and furniture were renewed and the machinery overhauled. The work was completed by William McKie in two weeks, and the steamer was again placed on her route.

STEAMER J. T. MORSE, AFTER BEING RAMMED BY THE BELFAST.

Cruise of the Salmon.

Recently the United States submarine *Salmon* made a voyage from the yards of the Fore River Shipbuilding Company, Quincy, Mass., to Hamilton, Bermuda, and return. This vessel is one of the latest types of American submarines, and is 134 feet 6 inches long by 15 feet diameter. When running at the surface she displaces 230 tons and in a submerged condition 345 tons. Her speed, as determined on her official trials, is 13¼ knots, and on her twenty-four-hour surface trial she averaged 12¼ knots.

The *Salmon* left Quincy on July 5 with twenty-one persons aboard. On the cruise a distance of 1,514 miles was covered, and 7,250 gallons of gasoline (petrol) were used. While in Bermuda her gasoline tanks were replenished and a few minor repairs were made. The *Salmon* returned to Quincy on July 17 in perfect condition. The voyage out was made on an average speed of 7.8 knots. A faulty cylinder gasket on one of the engines necessitated running under one engine alone during part of the voyage. On her return trip, with both engines operating satisfactorily, the speed was 9.7 knots.

It was intended that the boat should make the voyage unattended, but the underwriters insisted upon sending a tug with the boat upon the outward voyage. That no convoy was necessary, and that the submarine proved seaworthy and habitable in all kinds of weather, strongly emphasizes the increasing importance of the modern submarine as an adjunct to a seagoing battleship fleet.

SHALLOW DRAFT POWER CRUISER.

The power yacht Madge III., recently built by the Charles Ward Engineering Works, of Charleston, W. Va., for Mr. Charles Ward, involves some unusual features of design. The hull, designed especially for cruising on the inland rivers, is 86 feet 6 inches long, 11 feet molded beam, 15 feet over the guards, 3 feet 9 inches deep, with a draft of 2 feet, including the propeller. The hull is finely modeled, and built of No. 12 BWG steel plates. The frames are 1¼ by 1¼ by 3/16-inch steel angles, and there are four water-tight bulkheads.

LARGE SHALLOW DRAFT POWER YACHT MADGE III.

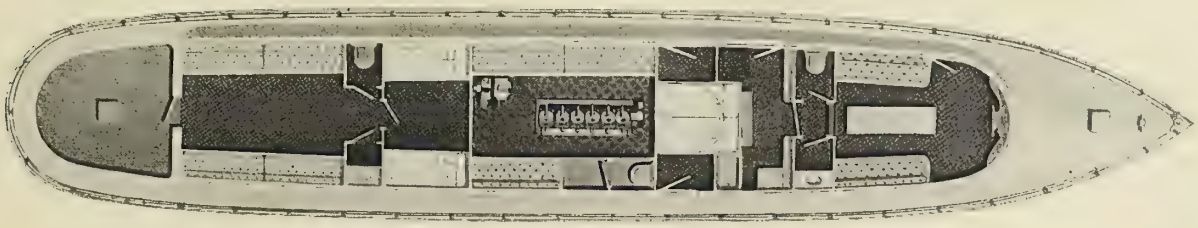
The deck is of 1 inch white pine, calked and painted. The forward deck is 13 feet long, with guards 2 feet wide, and the after-deck and cockpit 12 feet 6 inches long, under a standing roof, with brass railing 28 inches high around the entire boat.

The cabin or deck house is 60 feet 6 inches long, built of teak and arranged as follows: Forward is a cabin or dining room with circular front, 9 feet 9 inches by 13 feet, with folding table and two extension seats, making berths 30 inches wide. Immediately aft is a lavatory and toilet, with passage between leading to galley, which is 3 feet 9 inches by 10 feet 4 inches, fitted with china closet, plate racks, refrigerator, Shipmate range, sink, hot and cold water, shelves, etc., with doors to the dining room and deck. Aft of the galley are two staterooms 6 feet long, with two berths in each, the entrance being from the deck. The engine room is 10 feet 6 inches by 13 feet 6 inches, with room for three berths and a toilet for the crew.

The owner's stateroom, 6 feet 3 inches by 10 feet 5 inches, is located aft of the engine room and has two stationary berths, a dresser and drawers under one berth. A full-length mirror is placed in the door to the after-cabin. A toilet room is located just aft of the owner's stateroom, with a passage between the after-cabin, which is 10 feet by 12 feet, and fitted with four extension pullman berths, with an entrance from the after-cockpit.

The walls, bulkheads, doors and sashes are of mahogany; the ceiling and carlins of clear white pine. All sashes are glazed with plate glass and arranged to drop, except in lavatories, where they are hinged at the bottom. The cushions are of the best quality plush, filled with Ostermoor elastic felt, and the curtains are if silver gray velour, with roller blinds and carpet. The boat has in all sleeping accommodations for 12 people, not including three berths in the engine room.

The motive power consists of a 125 horsepower six-cylinder Standard gasoline (petrol) engine, air starting and reversible, driving a bronze propeller 36 inches in diameter, which works in a tunnel formed in the stern of the boat. Gasoline (petrol) tanks are located in the engine room under the berths and in closed compartments, which are seamless steel tanks of 425 gallons capacity. The floor and bulkheads in the engine room are of steel. The electric plant is a Standard combination outfit driving a 1½ kilowat direct current generator, with water service and air pump and a searchlight on the pilot house. The boat is steered from the forward cabin, the pilot wheel being conveniently located at the forward end.



PLAN VIEW OF THE MADGE III.

The deck fittings consist of one hand capstan on the forward deck. Access to the propeller is gained through a hatch

in the after cockpit floor and top of the tunnel, thus allowing the propeller to be removed and replaced without docking or employing a diver.

The speed of the boat as determined by the mean of two runs up and down stream is 15 miles per hour.

Loss of the British Cruiser Bedford.

Just as we are going to press news is received of the total loss of the British cruiser *Bedford,* which went ashore on the rocks off Quelpart Island, Korea, during speed trials between Formosa and Korea. Eighteen members of the engine room staff lost their lives, due to the sudden inrush of water, which filled the hull up to the engine room bulkhead. It is reported that there was a thick fog at the time of the accident.

The *Bedford* is 440 feet long on the waterline, 66 feet beam with a mean draft of 24 feet 6 inches. Her normal displacement is 9,800 tons, and on her eight-hour full-power trial she attained a speed of 22.7 knots, her engines developing 22,457 horsepower. She is driven by two sets of four-cylinder, vertical triple-expansion engines, and is armed with fourteen 6-inch guns and eight 12-pounders, besides smaller guns and two submerged torpedo tubes. Her side armor is 4 inches thick, and that on the barbettes 5 inches. She was laid down at Fairfield in 1900, and completed in 1903.

Race for the British International Motor Boat Trophy.

The annual race for the British International Trophy, or Harmsworth trophy, was held Aug. 20 over a 30-mile course on Long Island Sound. Two American boats, *Dixie II.* and *Nameless,* and two British motor boats, *Pioneer* and *Zigarella,* started. The *Zigarella* was first over the line and the *Dixie II.* and *Pioneer* three seconds behind her, and the *Nameless* some distance in the rear. The *Pioneer* quickly outdistanced all of her competitors and proved herself by far the fastest boat, but after gaining a lead of about a mile she became disabled by the clogging of her intake pipe, and before the difficulty could be overcome the *Dixie* had passed the disabled boat and gained such a lead that she easily won the race. The *Dixie's* average speed for the entire course was 34.7 statute miles an hour.

Condition of Machinery on Vessels of the United States Atlantic Fleet.

In the annual report of Rear Admiral Schroeder, U. S. N., commander-in-chief of the Atlantic fleet, interesting reference is made to the condition of the machinery and boilers of the various ships. The machinery and boilers of all ships are reported in good condition with the exception of the boilers of the *Ohio, Maine* and *New Jersey,* which, while these ships were with the fleet, were in poor condition. The standardization and full power trials which were held last winter in connection with the steaming efficiency competition under what might be considered average service conditions, resulted in a highly creditable performance of the fleet as a whole with the exception of the *Vermont, Rhode Island* and *New Jersey.* These ships failed to attain their contract speed through the unreliability of their feed pumps. In the *Connecticut* class the ships, save the *Vermont,* greatly exceeded the contract speed. In the *Virginia* and *Idaho* classes, save the *Rhode Island* and *New Jersey,* the contract speed was averaged, and the performance of the *Wisconsin* and *Missouri* was equally creditable when their age is considered.

Rear Admiral Schroeder comments on the steadily increasing tendency to make the ships self-sustaining, two ships, the *New Hampshire* and *Idaho,* having asked for nothing in the cognizance of the Bureau of Steam Engineering. Not only have repairs been effected in a large measure on board the ships themselves, but some things have been undertaken which are directed toward increase in efficiency over the original design. In this connection, Rear Admiral Schroeder refers to the valuable service rendered by the repair ship *Panther* during target practice and while at the navy yard in New York.

An exhaustive examination has been made by a board of inspection of the three measured mile trial courses over which United States vessels are given their official trials. Varying depths of water, conditions of tide, etc., affect the speed of the vessels so that different results are obtained when the ships are tried over the different courses. As a result of the investigation it has been decided that the Rockland (Me.) course is the best for all purposes; that the Provincetown (Mass.) course is the next best and the Delaware Breakwater course the least desirable, largely on account of the current prevailing in those waters.

It is reported that an experimental tank for testing ship models is to be constructed by Messrs. Vickers' Sons & Maxim at Barrow-in-Furness. At the present time only two private shipbuilding firms in Great Britain have thoroughly equipped model testing basins. These are Messrs. Denny and Messrs. John Brown. The great advantage gained by the use of such a tank in the design of ships makes the establishment of such apparatus almost a necessity in a large shipyard where a variety of work is done unless access can be had to a government tank.

The Lamport & Holt Line, which has been maintaining a fortnightly passenger service between New York and Rio de Janeiro, with a monthly service between New York and Buenos Ayres, has under construction three new ships, which, with the vesels now in service, will be used to maintain a fortnightly service between New York and Buenos Ayres by way of Rio de Janeiro. The new ships are to be 510 feet long, 61 feet beam, and of approximately 12,000 tons gross. They will be twin-screw vessels with a speed of 14 knots.

According to a press dispatch, the new 32,000-ton battleship which is being built by Armstrong, Whitworth & Company for the Brazilian government, will be 655 feet long over all, 96 feet beam and 26 feet draft. The armament will consist of twelve 14-inch guns, fourteen 6-inch and fourteen 4-inch guns, besides three 18-inch submerged torpedo tubes. The contract speed is to be 22½ knots.

The United States battleship *Delaware* made 21.5 knots on her recent four-hour full-speed trial, and averaged 19.74 knots on her twenty-four hour endurance run. The contract for this vessel required an average speed of 21 knots for four hours and 19 knots for twenty-four hours.

The German naval programme for 1911, as at present outlined, includes three battleships and one supplementary ship under the Novelle of 1908, and another cruiser battleship. Besides the capital ships the programme also includes two small cruisers, twelve destroyers and a number of submarines.

The new Cunard liner *Franconia* was launched recently by Swan, Hunter & Wigham Richardson, Ltd. She is 625 feet long over all, 72 feet beam, with a gross tonnage of 18,000. She will be propelled by twin screws driven by quadruple expansion reciprocating engines of about 14,000 indicated horsepower.

A New Combination Steamer.

The *Rotorua,* launched by Messrs. William Denny & Bros., Dumbarton, on July 12, is another notable example of the combination steamer. Besides being the largest steamer ever built at Dumbarton, she is also the second to be fitted with the new combination of reciprocating and turbine engines. The *Otaki,* the pioneer steamer of this type, was also built at Dumbarton, and for the same owners—the New Zealand Shipping Company of London.

The vessel is propelled by two sets of direct-acting, triple expansion engines and an exhaust turbine of the Parsons type. She is of steel, built under survey of the British Corporation. Her length, between perpendiculars, is 484 feet; breadth molded, 62 feet, and depth to upper deck, 35 feet.

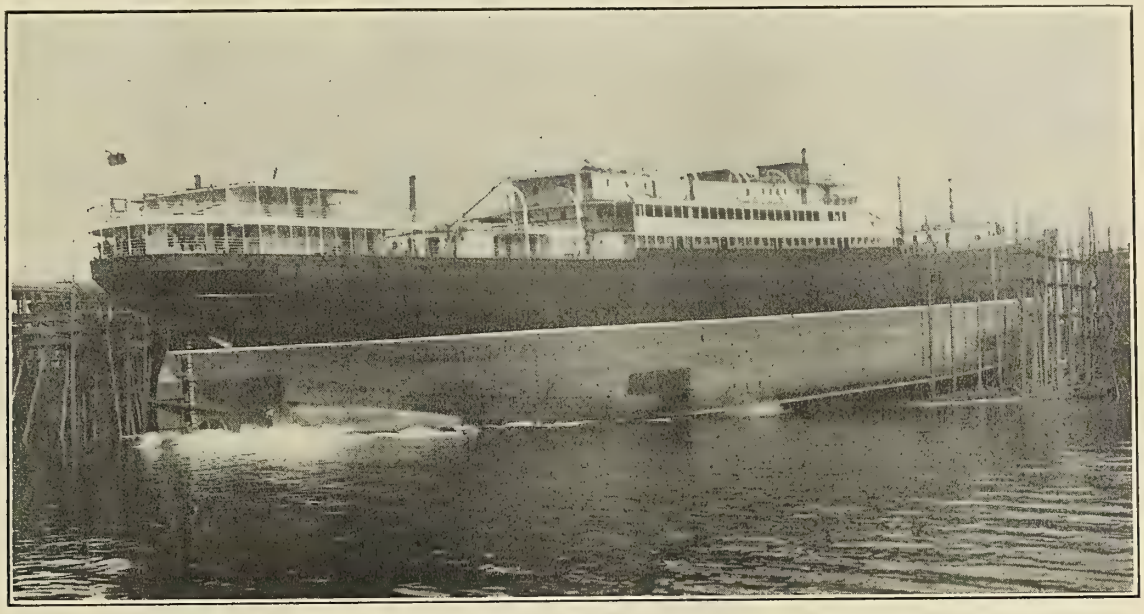
At the extreme fore end of the upper deck there is accommodation for seamen and firemen, and abaft this the storerooms and powerful refrigerating plant necessary to maintain a suitable temperature in the large insulated holds. Abaft the machinery space is the accommodation for the second-class passengers, who are provided with roomy cabins, having two, three, or four berths. Abaft this again is accommodation for third-class passengers, in two and four berth rooms, every room having natural lighting, in addition to electric lighting. On the shelter deck forward are deckhouses for the officers and stewards.

The midship portion is devoted to the accommodation of first-class passengers. The large midship deckhouse has at its forward end the first-class dining saloon. The framing is of stained and waxed oak in a classic design. In the after-end of this deckhouse is the second-class dining saloon, which is finished in white enamel, with mahogany furniture. There are eight large dining tables, with most of the seats on the revolving pattern.

Abreast the main mast is a deckhouse containing accommodation for the engineers. Above the shelter deck is a promenade deck for first and second-class, containing at the forward end the first-class lounge, vestibule and a number of special staterooms. The lounge is a spacious apartment designed in Adam's style and finished in ivory white. At the after-end is the second-class lounge and companion. The lounge is finished in white enamel, with mahogany furniture. Above the promenade deck and protecting it from the weather is a boat deck on which is the social hall. It is framed in oak, stained and waxed. On the other side of the companion is the first-class smoking room generally similar to the social hall and a play room for children. At the after-end of the boat dack is the second-class smoke room, panelled in polished lacewood.

Above the boat deck is the navigating bridge, containing chart room and wheelhouse, and fitted with all the latest appliances in navigating instruments, telegraphs, telephones and telemotor controlling the steering gear. This last is of the spring tiller pattern, so as to relieve the gear from all shocks.

The vessel is fitted with a complete installation of cargo gear capable of dealing with weights up to 25 tons. A number of cargo ports are fitted to facilitate the rapid handling of frozen meat, for the conveyance of which the entire fore-end of the vessel is insulated.



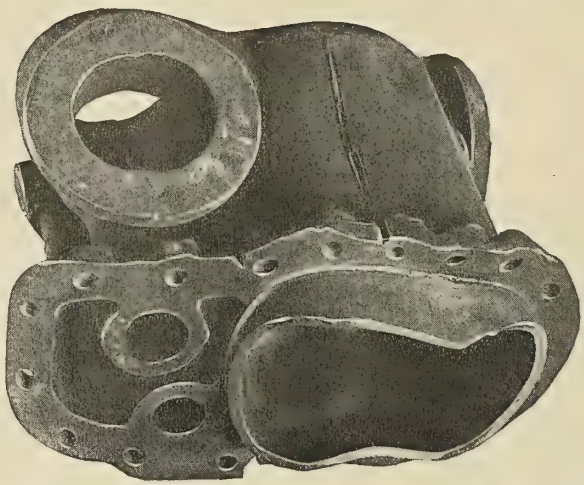
LAUNCH OF THE ROTURA; THE LATEST VESSEL TO USE THE COMBINATION OF PISTON AND TURBINE ENGINES.

Loss of the Perry.

The United States revenue cutter *Perry* was wrecked on Tonki Point, St. Paul Island, one of the Pribilof group of the sealing islands in Behring Sea, on July 26. The *Perry* was engaged in patroling these islands for the protection of the seal herds from the raids of Japanese poachers. There are no lighthouses, fog signals, buoys or other aids to navigation on these islands, and the strong current which sweeps around them carried the *Perry* ashore on a dangerous reef during a heavy fog. The *Perry* was 161 feet long, the smallest vessel of the patrol fleet. She was built in 1884 at Buffalo, N. Y., and was originally assigned to duty on the Great Lakes. In 1893 she was transferred to the Pacific Coast. In over fifty years this is only the second revenue cutter which has ever become a total wreck. The other loss was that of the *Gallatin,* which was lost in January, 1892, by striking a reef while attempting to enter Gloucester harbor in a blinding snowstorm.

The Bureau of Navigation reports that 124 sail and steam vessels of 38,372 gross tons were built in the United States, and officially numbered during the month of July, 1910. Nine steel steamers of 16,799 total gross tons were built on the Atlantic and Gulf coasts, and nine steel steamers of 18,139 total gross tons were built on the Great Lakes.

Vanadium Crucible Steel Cylinder Casting for Torpedo



Elastic limit - -	**65,000 lbs.**
Tensile strength - -	**80,000 lbs.**
Elongation in 2 inches -	**22%**
Reduction of area - -	**43%**

Study these figures and consider that under a steam hammer this Vanadium Steel Casting was distorted as shown without any sign of weakness or fracture.

Vanadium is the most versatile alloy known. Its benefits are astonishing in everything from small iron castings to armor plate; its action is uniform and dependable. It increases tensile strength to begin with, and ends by making wear-proof, anti-fatigue, non-crystallizing, tough and homogeneous parts, whether cast, rolled or forged.

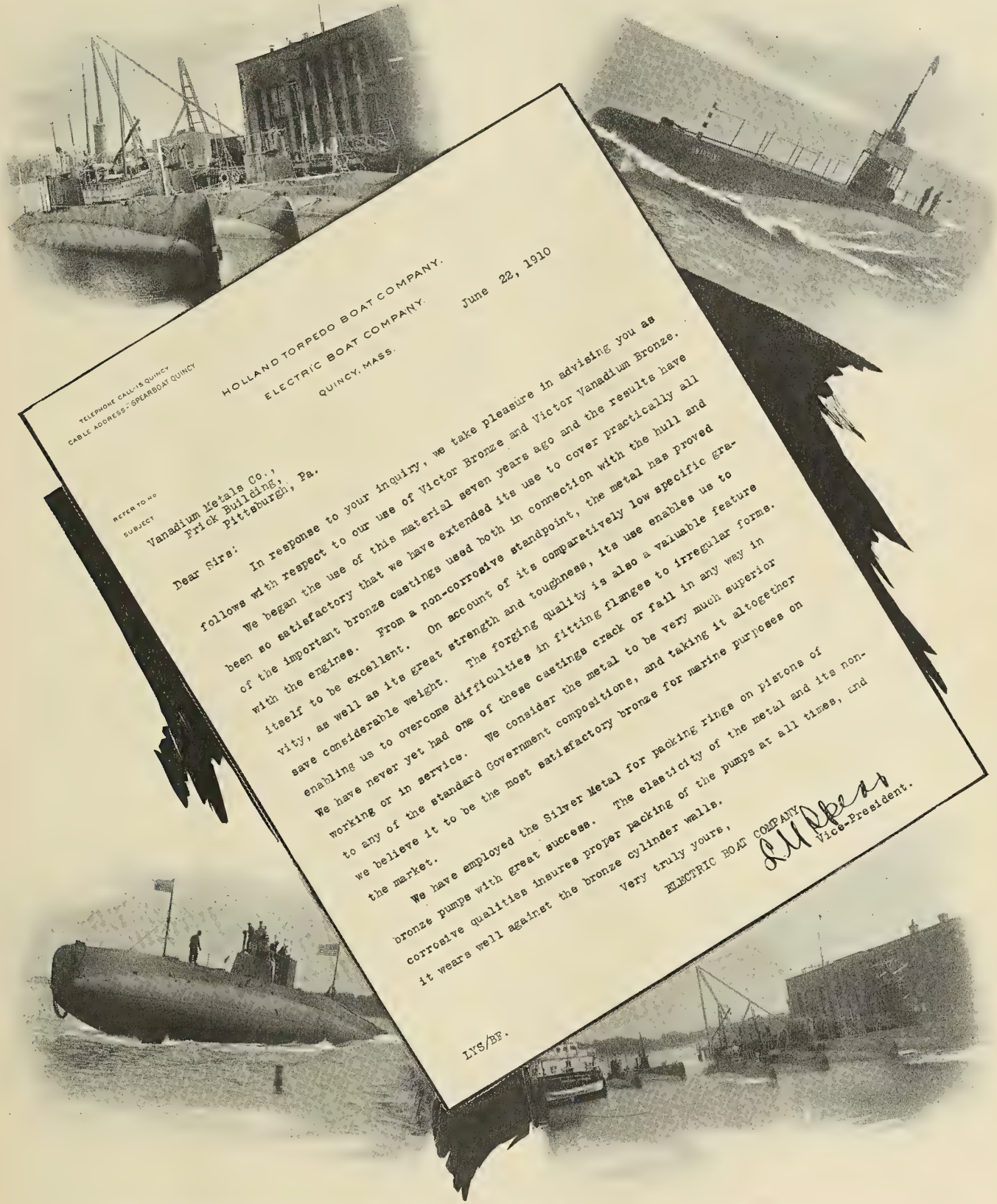
Strength for strength, Vanadium is the lightest steel ever produced. Cost for cost, it is the cheapest.

Booklets, tests, photographs, free.

AMERICAN VANADIUM COMPANY

318 FRICK BUILDING PITTSBURGH, PENNA.

A TESTIMONIAL



HOLLAND TORPEDO BOAT COMPANY.
ELECTRIC BOAT COMPANY.
QUINCY, MASS.

June 22, 1910

TELEPHONE CALL-IS QUINCY
CABLE ADDRESS:-SPEARBOAT QUINCY

REFER TO NO
SUBJECT

Vanadium Metals Co.,
Frick Building,
Pittsburgh, Pa.

Dear Sirs:

In response to your inquiry, we take pleasure in advising you as follows with respect to our use of Victor Bronze and Victor Vanadium Bronze.

We began the use of this material seven years ago and the results have been so satisfactory that we have extended its use to cover practically all of the important bronze castings used both in connection with the hull and with the engines. From a non-corrosive standpoint, the metal has proved itself to be excellent. On account of its comparatively low specific gravity, as well as its great strength and toughness, its use enables us to save considerable weight. The forging quality is also a valuable feature enabling us to overcome difficulties in fitting flanges to irregular forms. We have never yet had one of these castings crack or fail in any way in working or in service. We consider the metal to be very much superior to any of the standard Government compositions, and taking it altogether we believe it to be the most satisfactory bronze for marine purposes on the market.

We have employed the Silver Metal for packing rings on pistons of bronze pumps with great success. The elasticity of the metal and its non-corrosive qualities insures proper packing of the pumps at all times, and it wears well against the bronze cylinder walls.

Very truly yours,
ELECTRIC BOAT COMPANY,
Vice-President.

LVS/BF.

VANADIUM METALS COMPANY

FRICK BUILDING, PITTSBURGH, PA., U. S. A.

FOUNDRY, EAST BRAINTREE, MASS.

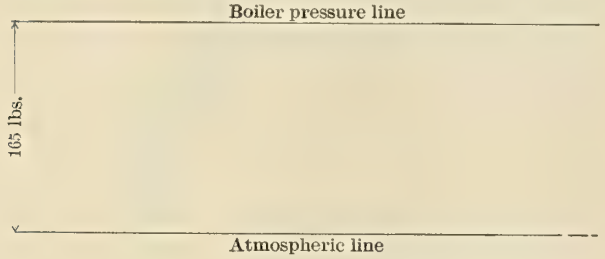
PRACTICAL EXPERIENCES OF MARINE ENGINEERS.

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

Indicating a Boiler.

It not infrequently happens in plants having a number of boilers in a battery or series of batteries, each fitted with from one to four safety valves and one steam gage, that there is a difference of from one to five pounds pressure in the point at which the safety valves lift. This means that the valve having the spring with the lightest tension will be the one that lifts whenever the steam reaches a higher point than that set for safety, and, in many cases, some safety valves are never lifted unless by some mechanical means installed for that purpose.

At the same time, perhaps, no two steam gages in the plant show the same pressure or correspond with the point of blow-off of the safety valves. This, of course, is not a desirable condition. The obvious and proper thing to do would be to



INDICATOR CARD FROM A BOILER.

summon an inspector, who, with a test gage, would set each safety valve on each boiler separately, and correct the error in the steam gages.

But in cases where a test gage is not immediately available the same desired result can be obtained by means of an engine indicator by the following method:

Having ascertained that the indicator is perfectly accurate, have pipe fittings of a suitable size connected to the steam space of each boiler. Cut out the boiler, having valves to be tested, from the battery, gag all safety valves on that boiler except the one to be tested. Attach the indicator in the usual manner, after having blown steam through the pipes to clear any dirt or grit that may have been in them. Raise steam slowly in the boiler until it reaches the blowing-off point. Then, after placing the paper on the drum of the indicator in the usual manner, open the cock to the atmosphere, and, while holding the pencil against the paper on the drum with one hand, pull the cord with the other hand, thus drawing the atmospheric line. Then, after the indicator has been properly warmed by admitting and releasing steam to the cylinder by means of the cock, open the cock full, admitting the full boiler pressure, then draw a second line in the same manner as before described. This line will be the boiler pressure line. Then by measuring with the scale suitable for the spring used on the indicator, the distance between the two lines will give the pressure on the boiler at the point at which the valve being tested blows off. If no scale is available, measure the distance between the lines in inches and fractions thereof, and multiply by the number of the spring used on the indicator.

This operation can be done in a very few minutes, and as each valve is corrected the reading of the steam gage on the corresponding boiler should be noted and corrected, the operation to be repeated on each valve of each boiler until each valve blows off at the point allowed by law, and each steam gage gives an accurate reading. W. K. Q.

How a Spare Propeller and Shaft were Fitted at Sea.

We were on a voyage from Bombay to Dundee, Scotland, in ballast trim, when our ship lost its propeller through the breaking of the tail shaft, just outside the stern tube. As the vessel was in the Indian Ocean, near some very inhospitable islands, the inhabitants of which are noted for their man-eating propensities, and as a strong current was setting towards those islands, our captain and chief engineer determined to attempt to fit the spare propeller and tail shaft which we had in the hold. This feat we managed to accomplish under very trying conditions, but in an entirely satisfactory manner. In order to prevent the vessel from drifting and rolling, a sea anchor, consisting of a long derrick having sails weighted with chains attached to it, was let out, and, as a further preventative, one of the anchors, with 30 fathoms of chain cable, was lowered away. This lessened the leeway considerably, but, owing to the boisterous, squally weather, the vessel continued to roll easily during all the time we were replacing the propeller and tail shaft.

While the captain and his officers were making preparations for lifting and slinging the propeller, the chief engineer and his staff were very busy down below disconnecting the shafting, and chocking it up. They also rolled the intermediate length to one side, and made it fast there. Our next job was to cut a plate off the tunnel top, and, as it turned out, it was a very difficult job, owing to its being an inside plate. Finally, however, all was made ready for removing the broken shaft. The propeller was then unshipped in the hold and lowered away on to the floor of the hold, with, of course, the large end of the bore up. Having done this, we lifted the spare shaft on end and tried it in the bore of the propeller boss. We had previous to this taken every precaution to see that the taper and key were a good fit. All being now ready for fitting the propeller and shaft, orders were given to fill the fore peak, tanks and fore hold, the water in the latter being only up to the outside level of the water.

After this was done, we started to get the broken shaft in, and after about 12 hours' solid work we managed to land it into No. 4 hold. A wooden plug was fitted to the shaft hole on the outside. This kept nearly all the water out. Our next job was to get the new shaft into place. This job took us 24 hours' solid work to finish; we had to make a Muntz metal cap, to go over and protect the threads on the nut end of the shaft. This Muntz metal cap was run out flush, with the guard ring pushing the wooden plug out at the same time.

Everything now being ready for fitting the propeller, the difficult and dangerous operation of lifting a mass of metal of over 8 tons over the side of the vessel and passing it under the stern had to be accomplished while the vessel was rolling in the trough of the sea, which was a very heavy one at the time, and which also prohibited the use of either boats or rafts.

As all the hatches were fitted with two derricks, both derricks were utilized for the lift, the two being lashed together

at the top and fitted with preventative spans on each, about 6 feet in, both being lifted together. The goose necks being 4 inches in diameter and extra strong, it was not deemed necessary to add any further support to them. The masts did not go through the deck, but were secured to it by heavy gusset plates, and, as the deck was supported by heavy through beams and longitudinals, no further support was added and did not prove necessary.

The purchases used were small mooring wire ropes, fastened to the derrick ends and acting as top block, and so on down to the winch barrel. We thought it better to try the gear, when fitting the shaft, and this we did and found it worked very satisfactorily. The propeller was now slung round the boss, the sling being well secured with small chain lashings, all terminating at the top or keyway side, so as to be easily undone when the propeller was fitted on to the shaft. In order to steady the derricks, when making the lift, four tackles were used as guys, two on each side, these being shifted at one time, as required. At a favorable moment the lift was made, and, when clear of the hatch combings, the derricks were guyed over a little and then the propeller was safely landed and secured on the starboard main deck.

The derricks were then guyed further over, a gin block was made fast to the center eyebolt under the counter, and another to the propeller, from which a wire rope tackle was led from the capstan aft, through the starboard fair lead, to a gin on the propeller, then to a gin under the counter, and the end made fast to the propeller. A large wire rope was then led from the forward capstan over the port bow, right along the whole length of the vessel's side, through the screw aperture and round the starboard quarter and made fast to the propeller boss. A similar wire rope was led from forward along the starboard side, and also made fast to the propeller boss.

Every precaution having now been taken to prevent the propeller from swinging and smashing in the ship's side, the propeller was lifted, and, at the first roll, it was allowed to slide over the ship's side into the water by lowering away the derrick tackles and starboard forward wire. At the same time the after capstan began to heave on its tackle, and the forward capstan on the forward port wire. This immediately brought the propeller well under the counter into a comparatively quiet position. Blocks and tackle having been hung from the eyebolt under the port counter were made fast to the propeller and secured. The lashings were then taken off the derricks, and after unhooking the port derrick tackle it was passed over the port counter, through the screw aperture, and made fast to the propeller once more.

Another lift was then made and the propeller was brought into position, blocks being hung from the starboard eyebolt and made fast to the boss. The propeller was thus held up and forward by the derrick tackles, up and aft by the tackle to the center eyebolt, up and against the body post by fore and aft wires and sideways by the tackles to the propeller lifting eyebolts.

We encountered considerable trouble in entering the shaft and key into the propeller boss, owing to the inclination of the shaft due to the trim of the vessel, and we only overcame this by taking off the weight now and again. We took the greatest care in handling the nut, lashing it securely and making it fast to the deck; the lashings were only removed when the nut had been screwed up three turns. To have lost the nut would have been just as great a disaster as losing the propeller.

After the "Monday" had been used vigorously for some time, and the propeller set hard up, the set pin was driven home and the most difficult work completed. The shafting we soon afterwards coupled up, replaced the bearings, warmed the engines through and started them very slowly. The voyage was once more resumed after the repairs had taken 8 days and 20 hours. When we consider the difficult nature of the work so successfully accomplished, and in so short a time, the lifting of a heavy mass of metal from the hold to the stern of a rolling ship, the fitting it on while at work on a plank 6 inches wide, one minute immersed five feet in the water, and the next minute 15 feet in the air, hanging on to a heavy hammer or key or nut, the loss of which meant failure to us and to the success of the whole undertaking, or when we consider the great risk of a sudden storm coming on when the loose propeller was hanging from the stern, the pluck, energy and ingenuity of the captain, the chief engineer and their respective staffs, will, I think, be appreciated by all in both professions. F. J. S. N.

Modification of Pump Plungers.

The following relates to changes in pump plungers as carried out in several ships of the United States navy by Chief Machinist E. Evans. The Blake pump is used to a large extent in the naval vessels and gives excellent service. The plungers of these pumps are constructed of composition, and are fitted with two outer rings of lignum vitæ and one inner ring of composition. The inner ring is split in one place only; the outer ring is pressed against the walls of the cylinder by adjusting bolts and springs (see Fig. 1). In time this adjustment tends to wear the cylinder out of parallel, in consequence of which the piston, or plunger, allows the water to pass from one side to the other. Sometimes, due to long use and insufficient time for examination, this plunger carries away; oftentimes material for springs cannot be found, and

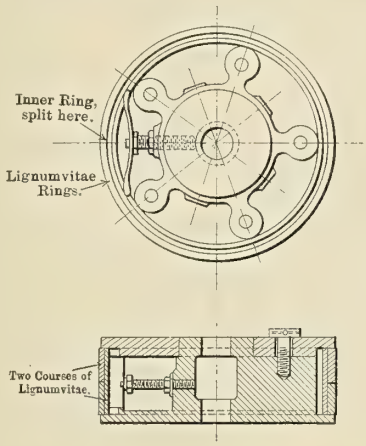


FIG. 1.

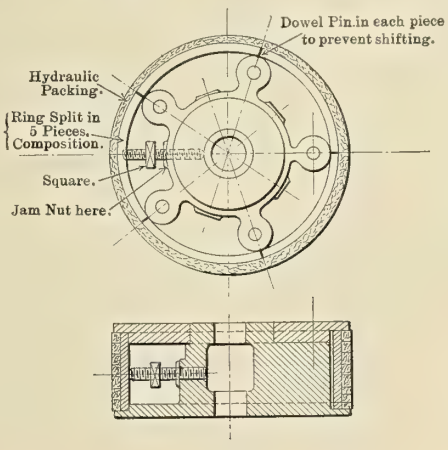


FIG. 2.

for the moment one is apt to have radical ideas as to the ultimate destination of the drawing office.

However, a simple, quick and efficient modification can be made by turning the lugs to a smaller diameter, then fitting a ring split in five pieces. The space between the rings and the walls of the cylinder are packed with hydraulic packing. This packing is set out by adjusting screws. This modification wears the cylinder evenly, and the hydraulic packing gives a fine, smooth, hard glaze to the cylinders.

Arthur A. Smith,
Machinist, United States Navy.
U. S. S. *Charleston*, Chefoo, China.

Safety Appliances on Submarines.

Ever since submarines were first introduced, brainy men have been at work devising methods by which dangers to their crews can be reduced to a minimum. Those who are used to serving in these deadly little crafts will tell you that these dangers are not as great as is usually imagined, and that the loss of life from accidents has really been comparatively small.

The two great dangers are collision and explosion, and special attention has been given to methods that will prevent loss of life in case of accident from these two sources.

When the submarine is submerged, it is really half blind; for the periscope is only a makeshift eye. But even this has been greatly improved. Formerly the lens in use only allowed half the horizon to be examined unless the periscope was turned around. It could, therefore, happen that a ship might come up unnoticed and strike the submarine before it could dive into safety. It was in this manner that the British *A* 1 was sunk by the *Berwick Castle*. Now, however, a new lens has been devised which gives a complete view all around, so that an approaching vessel can be seen from whatever quarter it comes.

Another danger is escaping gasoline (petrol), which may lead to an explosion. By the regulations the engine must be stopped as soon as an escape is noticed; bad accidents being caused a few years ago by neglect of this precaution. In the early days of submarines, mice were kept on board, as they were affected by an escape of gasoline (petrol) long before the crew noticed it. They would run about, squeak violently, and show every sign of distress. But now the engines make so much noise that their squeaking would not be noticed. At present a more scientific method of detecting the escape of noxious fumes is in use. Two engineers employed at Portsmouth have invented an apparatus that registers the escape of gasoline (petrol) or other gases, coming into action long before sufficient can have escaped to form an explosive mixture. By an ingenious contrivance a red light is substituted for a white one and a bell is rung when there is a leakage of gas.

Sometimes sea-water will penetrate into the accumulators—a very serious danger, as chlorine is thereby evolved which may suffocate the crew. The *A* 4 had a very narrow escape in this way, but fortunately one of the attending ships was near and opened the hatch as soon as it was seen that something was wrong. Thanks to another invention, however, this deadly gas is now rendered comparatively harmless.

A safety helmet, somewhat resembling that worn in mine explosions, is now provided. Attached to a watertight canvas jacket that straps round the waist is a big helmet with a glass front, not unlike that of the ordinary diver. Just below the front of this is a magazine containing a special substance called "oxylithe," which has the power of giving off oxygen and absorbing the carbonic acid in the air when it comes in contact with water. In this manner the wearer of the helmet has always a good supply of air to breathe, so that in case of the evolution of chlorine the crew would hastily don these jackets.

The helmets have still another use; for, being full of air, they serve as life buoys. Thus, in the event of a submarine being struck by a passing ship and punctured, these jackets would be put on at once. Then the hatch could be opened and the men would float to the surface. However, if the hole were large, the water would pour in so quickly that there would be no time to get into these. But British inventive genius has not found this difficulty too great to solve, and now all submarines are being fitted with a very simple little safety device.

As soon as a submarine leaks, the water fills the bottom and pushes the air to the top, where a certain quantity is always held in any odd little corner near the ceiling. Therefore, thin steel partitions, depending a foot or two from the ceiling, in places where it slopes or forms corners, are being fitted in order to form air traps in different parts of the interior. Thus, when a bad leak occurs, quickly filling the submarine with water, the air is pressed into these traps. The crew immediately seize their helmets and stand with their head and shoulders above the water in the air traps, so that they can breathe while putting on the safety dress.

Another invention that has been tried in one or two of the underwater craft consists of a long flexible tube attached to the outside. At one end is a float, while the other communicates with the interior. In the event of an accident, this tube is liberated and is at once borne to the surface by the float, to which is attached a flare to give notice to any ship near at hand; until the submarine is raised, the crew can breathe through this tube, or food might even be passed down.

At least one American vessel is fitted with a door through which the crew can escape if necessary. This door opens into a chamber which, in its turn, communicates with an airlock. If it is desired to leave the submarine, a diving dress is donned and the airlock entered. The door communicating with the interior of the vessel is closed, and then the diver goes into the outer compartment, closing the door of the airlock after him. Water is then allowed to enter, and, when it is full, he merely opens the door and steps out. The door is then closed and the water pumped out again, so that others can follow.

Andrew Lewis.

Partial Collapse of After Engine.

The steamship *C*———— was on a voyage from Kobe, Japan, to London, via the Suez Canal; for fourteen days after we left Kobe everything was running smoothly and well, when suddenly, without any warning, the after engine collapsed. The first thing we did was to shut off steam and ascertain the damage. It was found, on examination, that the connecting rod, piston, cylinder and cover were broken, the tail rod was bent, and the lever bearing and front column smashed. The first thing to give way was the connecting rod foot, which broke right in two, while on the upward stroke, allowing the piston to come with a tremendous bang up against the cover, breaking piston and cover and cracking the cylinder. The parts then fell to about half-stroke, the broken connecting rod hanging well into the crank pit, the cranks again coming round caught the end of the rod, and forced it right through the column foot, thus bringing the engine to a dead stop.

The first thing we did was to disconnect the top end, and get down the bent and broken connecting rod, we then removed the low-pressure steam chest cover and disconnected

the valve from the spindle, shoring it in its middle position and then working her non-condensing by allowing the steam to flow from the high-pressure exhaust around the high-pressure to the low-pressure steam chest, and so into the atmosphere. After all this was done and a great deal of hard work accomplished, she was once more started under a fair head of steam, and then we worked the boilers down to 40 pounds of steam by the gage, which was all they could supply. After a run of four and a half days, a port was reached, where repairs could be effected.

On wiring home, an answer was received to the effect that a new cover, piston, piston rings and springs and connecting rod would be sent. Those in charge then started to patch the cylinder by means of a ½-inch steel patch, secured by ⅝-inch tapped bolts, having first drawn the cylinder to a level on the top edge by means of a strong plate.

On arrival of the new parts they were fitted up, and the vessel got under way, everything working well. After steaming for five and a half days, the self-same accident occurred again, this time wrecking the cylinder and piston rod as well as the parts mentioned before, except in this case the column was untouched, the connecting rod breaking in the middle of a very bad weld, that had been made in the rod, the clean iron showing on examination of the broken parts, only a small percentage of the entire welding surfaces. The broken parts were again disconnected and the engine got under way as before, with a run of eight days before her. The management of the boilers gave us great trouble during this run, as no blowing down could be done, owing to the bad state of the feed donkey. It took every effort to supply enough feed to the boilers to ensure steam, let alone any water for blowing down.

The boilers were worked as follows: When one showed very great density it was laid off and the other used for steaming, the laid-off one in the meantime cooling off; it was then blown down, run up again, fires were set away and steam got up to 70 to 80 pounds by the gage, then this boiler was put under way and the other treated in the same way, changing boilers about once in every thirty-six hours. Having reached port and moored, orders came to go further up the harbor; two tugs were engaged; the engines of the ship giving all the assistance that lay in their power. The tugs, however, from some misunderstanding, cast off the ropes and refused to take them up again. The chief engineer was then asked if he could work the engines to take the ship to her discharging berth among the other vessels. His reply being yes, the engines were then worked ahead and astern, according to the telegraph.

New parts having been again supplied and fitted, she proceeded on her next voyage without any further casualty.

F. J. S. N.

Fracture of High-Pressure Junk Ring and Bolts.

The steamship "A———" was on a voyage from London to Philadelphia, with about 5,000 tons of general cargo. Three days after leaving London, the exact time being 10 A. M., a slight bump was heard in the engines, followed at each revolution by a heavier one. The third engineer was on watch at the time, and, thinking something had come adrift about the pumps, ran round back of the engine to see if such was the case, but seeing nothing wrong there, and the noise continuing, he stopped the engines. On making a careful examination, all seemed to be in order, so she was slowly turned, and, as the high-pressure engine reached the top center, the bump was heard in that cylinder. The fire were partly drawn, safety valves eased, and then a message was sent on deck to let the captain know that the engines were temporarily disabled. We next put in the turning gear and then proceeded to lift the high-pressure cover; having taken the cover off, we found lying on the piston top two of the junk ring bolts, which were luckily in such a position that the bolt heads instead of coming against the cylinder cover and splitting it, had fallen directly under the escape valve opening, and fouled the body of the bolts only. There was a good clearance on the top, but the concussion had been heavy enough to split the junk ring in five places, and knock a piece out of it. We then stripped the piston and found that the bolts had broken at just the last thread in the nuts, and these being fitted in recesses in the side of the piston body were easily withdrawn and replaced by spare ones.

Four more bolts were found cracked in the same way and were renewed. It so happened that there was a spare junk ring on board, but it was 1½ inches too large, belonging to a cylinder which had been replaced by one of less diameter. This ring was reduced by chipping to a suitable diameter, the bolt holes were also cut out to suit the bolt centers, and the ring fitted in place of the broken one. We also drew out the check rings and refitted them, we then closed up the cylinder, took the turning gear out and set the engines going ahead slowly for a while. Full speed was soon resumed, and we completed the voyage without further mishap.

The primary cause of the breakdown was undoubtedly due to the floating ring having too much play, nearly 3/16 inch, instead of being only just able to move it. The secondary cause we found to be that at some previous time all the nuts had been renewed, but, at the same time, they had not been bedded on their seats, so that on screwing the bolts hard up the nuts did not bear all round, but on the corners only, thus bending the bolts to begin with, and enormously weakening them. We did not discover this until we reached port, and on examining the piston three of the new ones were found cracked as before. This led to all being refitted. The junk ring was also refitted and adjusted properly to the floating rings.

A Broken Crank Shaft.

The steamer "C——," when in the Indian Ocean, broke her crank shaft at the after end of No. 2 main bearing. A very stormy southwest monsoon was blowing, which made it very difficult to work, as the vessel was being put under all sail with the wind and sea abeam. However, the shaft was effectively repaired, and we afterwards steamed at a little under half speed against the storm to Point de Galle, a distance of 500 miles. Here we waited until the gale had gone down, and then proceeded slowly to Port Said; we stopped occasionally to lift the top brass to see if all was well, gradually increasing the speed as confidence was gained. On our way to Port Said we called at Aden, where we held a general examination, and during the latter part of the Red Sea passage and through the Suez Canal full speed was maintained. On our arrival at Port Said a new shaft was waiting for us.

The repair was made in the following manner: The fracture in the shaft was half in the web and half in the crank pin. Four holes one inch in diameter were drilled in the web, one at each side and two on the top corners. These holes were then tapped at 1⅛ inch and studs were made to suit. Then we made and fitted a steel band, but before this was finally put on, a dove-tail was cut into the crank pin and web, and a dove-tail was fitted to it, and was screwed in its place by two one-inch steel studs.

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Practical Experiences of Marine Engineers.

During the past year we have devoted a few pages of each issue to articles contributed by men from the engine room, describing their experiences under various trying circumstances, such as are occasioned by breakdowns, mishaps and accidents of various kinds. The number and variety of interesting and valuable repair jobs which have thus been described have no doubt surprised many of our readers who, in the course of their sea-going experience, have had comparatively few difficulties of this nature to overcome. The ingenuity and resourcefulness displayed in making difficult repairs with inadequate tools and materials show that, although many of the dangers of the deep have been overcome, yet the same heroic spirit which characterized the old-time sailor in the performance of his dangerous calling still prevails in slightly different form below the grating of a modern steamship. Much of the spectacular and picturesque life of the sea has vanished, but in its place has grown up a profession which calls for the same courage and hardiness in overcoming difficulties. The forces with which the marine engineer has to deal in the engine room to-day are many times greater and more dangerous than those with which the old-time sailor battled above decks. That the many serious and minor breakdowns and mishaps which occur on steam vessels now result in neither loss of life nor injury to the passengers and crew, nor in irreparable damage to the vessel itself, speaks well for the efficiency of the marine engineer.

Although most of the articles which we have hitherto published under the head of practical experiences have dealt with breakdowns and repairs, yet we hope that the man who escapes these troubles and who keeps his vessel in smooth working order month after month will not consider it of too little interest to write and tell his friends how he accomplishes this result. Every engineer admires a smoothly running and efficiently operated plant on board ship, but the engines, boilers and auxiliaries of a steamship cannot be kept in such excellent condition without a continual exercise of knowledge and skill on the part of the engineer in charge. In maintaining an efficient, safe and reliable plant there are numberless topics worthy of discussion, and we hope that our readers will in future include such material in their contributions to the Department of Practical Experiences.

Motor-Driven Ships.

The announcement that the Hamburg-American Steamship Company is building a 9,000-ton vessel, to be propelled by Diesel engines, aggregating 3,000 horsepower, has occasioned much comment and speculation in the daily press, which would easily lead the uninformed to believe that this type of propulsion is to be extended immediately to the largest ocean liners and the latest *Dreadnoughts*. Press dispatches also intimate that the application of internal combustion engines to battleships will revolutionize warship construction and immediately render obsolete the most modern battleships and cruisers.

We have no hesitancy in calling such reports absurd; for the powering of a 27,000-ton battleship with internal combustion engines capable of driving the ship at a speed of 20 knots is to-day an impossibility. Until very recently, the largest marine internal combustion engine built was of 500 horsepower, and engines of that size were of the six-cylinder, double-acting type, so that considerably less than 100 horsepower was developed in each cylinder. The immediate development of the internal combustion engine into such sizes as would call for the production of a 1,000 horsepower in each cylinder is beyond the bounds of possibility in the present stage of the art of engine building.

The experiment of the Hamburg-American Steamship Company building two 1,500 horsepower Diesel engines to drive a 9,000-ton vessel at a speed of 12½ knots, will be watched with great interest, since the use of internal combustion engines for moderate-powered vessels has frequently been urged, provided the cost

of operation could be reduced to a reasonable figure. The fuel used in this case will be petroleum residue, which is the cheapest variety of fuel oil obtainable, and as the vessel is to be regularly engaged in transatlantic service, an adequate supply of fuel is insured at the terminals of the line.

With the question of an adequate supply of fuel at a reasonable cost disposed of, the adoption of this means of propulsion for this type of vessel offers a number of striking advantages. In the first place the steam-generating plant, with its enormous weight and troublesome up-keep, is done away with entirely. The bunker space is also cut down materially, so that there is a large saving in space, which can be used for cargo or passenger accommodations. Maintaining an efficient and intelligent fireroom force on a steamship is one of the greatest troubles with which a marine engineer has to deal; in the motor-driven ship this difficulty is entirely overcome, since only a small force is required in the engine room. The engine plant itself will, of course, be heavier than steam engines of the same power, but this added weight is but a small fraction of the weight gained through the elimination of the steam-generating plant. Moreover, the multiplication of units by the use of twin screws in a motor-driven vessel where a single screw would have been used in a steam-driven vessel of this size adds a factor of safety to the vessel, which is always gained by the use of multiple screws. It is doubtful whether anything will be gained in propeller efficiency, since the large, slow-speed single propeller of a cargo boat can be designed to have perhaps greater efficiency than almost any other type of screw. On the other hand, the use of twin screws permits placing the propellers in more advantageous positions relative to the stream line flow around the ship.

As to the relative economy of the steam and motor-driven ship, this is something which must be determined by tests after the installation is made. Without even approximate figures as to the cost of equipment, added cargo-carrying capacity of the motor-driven vessel over the steam-driven vessel, and the exact cost of fuel in the two cases, together with the actual economy of the oil engine, it is impossible to make even a fair guess as to the relative cost of operation in the two cases. Information regarding this point, however, will be awaited with much interest, and experience with a vessel of this size will give a valuable check on estimates which have previously been made for this type of propulsion.

As to the use of oil engines for warship propulsion, it is only necessary to recall the fact that warships must be able to operate in any part of the world and that they must be able to secure a supply of fuel at all ports. The supply and distribution of oil fuel is not yet adequate to warrant its use exclusively on war vessels, otherwise it would now be more generally used for fuel under the boilers. If internal combustion engines are to be adapted to warship use, it is more probable that it will be the gas engine using producer gas, although as yet the development of this type of propulsion is limited to such small powers that its use for warship propulsion is entirely out of the question. Even if oil engines or gas engines operating on producer gas could be applied to warships to-day, the claim that their use would revolutionize warship construction and render obsolete the most modern battleships and cruisers would be an absurd statement. The use of these engines would give some advantage in reduction of weight of the power plant which could be allotted to armor or armament, and the elimination of large smokestacks would enable the guns of a warship to be placed in more commanding positions. In reliability and speed, however, the motor-driven ship would very likely lose as compared with the turbine-driven ship, and after balancing up the advantages and disadvantages of the motor-driven warship it is difficult to see how it could possibly render obsolete the modern turbine-driven vessel.

Old Transatlantic Packet Ships.

Records of transatlantic travel before the days of steamships are somewhat incomplete. Fiction has dealt with this period to a certain extent, but accurate accounts of the vessels which were used at that time and of their performances and the general conditions of the service are difficult to find. Still more rare are engravings, prints or sketches of these old vessels, and it is only at the expense of much time and money that a collection of such pictures can be made. One of our contributors this month, who has made a careful search for this material for a good many years in out-of-the-way places, gives in brief form the history of the old transatlantic packet ships in whch the bulk of passenger and cargo trade was carried before the days of the steamship.

Brief as this article is, it mentions the more important companies which operated these packet lines, calls to mind the names of many of the well-known captains of the period, and describes with some detail the type of vessel employed in the service. Remarkable sailing records were made in those days, and in this as well as in many other matters pertaining to the general efficiency of the service credit must be given to the hardy American seamen and officers who manned the ships. By their indomitable courage and expert seamanship they were able to compete for many years with the rapidly-encroaching steamship. How the transatlantic steamship was developed and finally drove the sailing packet from the seas will be told by the same author in our next issue, and the article will be illustrated by many reproductions of rare prints and engravings.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

BATTLESHIPS.

	Tons.	Knots.		July 1.	Aug. 1.
Florida	20,000	20¾	Navy Yard, New York.....	68.8	71.0
Utah	20,000	20¾	New York Shipbuilding Co...	80.0	83.2
Arkansas ...	26,000	20½	New York Shipbuilding Co...	34.6	39.5
Wyoming ..	26,000	20½	Wm. Cramp & Sons.....	28.4	32.3

TORPEDO-BOAT DESTROYERS.

Paulding ...	742	29½	Bath Iron Works.....	92.4	93.4
Drayton	742	29½	Bath Iron Works.....	86.1	88.1
Roe	742	29½	Newp't News Shipbuilding Co.	92.3	97.1
Terry	742	29½	Newp't News Shipbuilding Co.	89.7	91.5
Perkins	742	29½	Fore River Shipbuilding Co...	86.8	92.3
Sterrett	742	29½	Fore River Shipbuilding Co...	83.8	88.4
McCall	742	29½	New York Shipbuilding Co...	85.4	89.6
Burrows	742	29½	New York Shipbuilding Co...	85.2	87.5
Warrington..	742	29½	Wm. Cramp & Sons.....	74.4	79.5
Mayrant	742	29½	Wm. Cramp & Sons.....	79.1	80.8
Monaghan ..	742	29½	New'pt News Shipbuilding Co.	26.7	28.4
Trippe	742	29½	Bath Iron Works.....	49.9	56.7
Walke	742	29½	Fore River Shipbuilding Co...	39.1	47.6
Ammen	742	29½	New York Shipbuilding Co...	48.5	56.3
Patterson ...	742	29½	Wm. Cramp & Sons.....	33.0	40.7

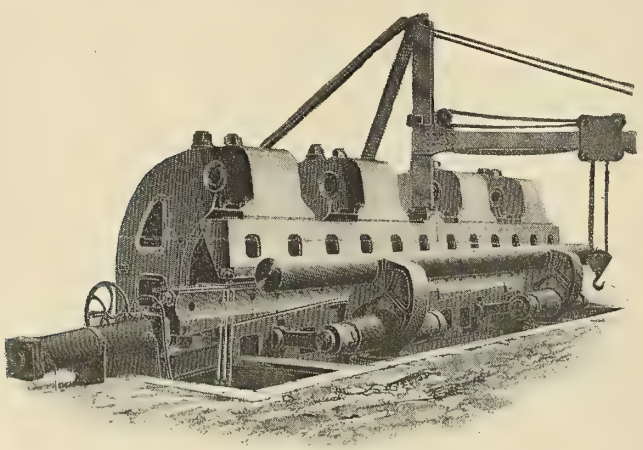
SUBMARINE TORPEDO BOATS.

Salmon	...	..	Fore River Shipbuilding Co...	97.4	97.8
Seal	...	..	Newp't News Shipbuilding Co.	51.2	52.2
Carp	...	..	Union Iron Works.....	58.6	60.0
Barracuda ..	...	..	Union Iron Works.....	58.6	60.0
Pickerel	...	..	The Moran Co.....	53.1	56.8
Skate	...	..	The Moran Co.....	53.1	56.8
Skipjack	...	..	Fore River Shipbuilding Co...	45.3	48.6
Sturgeon ...	...	..	Fore River Shipbuilding Co...	43.7	46.2
Tuna	...	..	Newp't News Shipbuilding Co.	28.3	29.9
Thrasher ...	...	..	Wm. Cramp & Sons.....	6.4	7.9

ENGINEERING SPECIALTIES.

Patent Hydraulic Keel-Plate Bending Machine.

This machine has been designed for bending steel plates, cold, for ships' keels, for doing all kinds of straight flanging for floor plates, bulkheads, intercostals, deck houses, tanks and other ship work, effecting a great saving both in weight of material and riveting. With this machine it is not necessary to heat the steel plates, and not only is a great saving effected thereby, but the danger of injuring the plate, by causing local



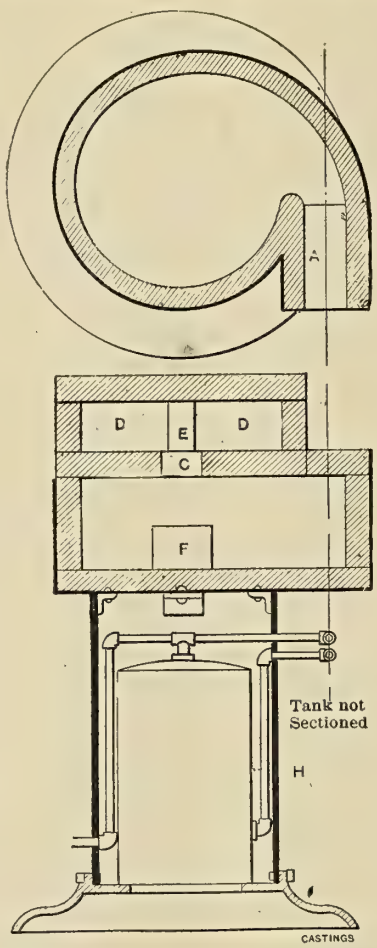
strains, due to unequal heating, is obviated. The plate also comes from the machine with the flange set perfectly straight and fair, and the body of the plate free from buckles or marks of any kind. The speed with which the work is accomplished is a special feature, as it is claimed that each plate is gripped and flanged in three or four minutes.

The plate is held fast in the machine by sliding wedges actuated by a horizontal cylinder and ram. The bending or flanging of the plate is accomplished by a roller of best forged steel, actuated by two large vertical oscillating cylinders. The roller is adjustable in and out for bending light and heavy plates, having steel links and screws worked by steel nuts, worm wheels, worms and large hand wheels. With this arrangement of links and screws the roller is adjusted, and the bending moment for light and heavy plates is the same throughout the operation of bending, *i. e.*, the roller follows the plate at an equal distance from the bending point throughout the process of bending. The beam against which the plate is bent is made of best "Siemens" cast steel, and is arranged so that double flanges for flat-bottomed vessels may be bent. A keel plate may be bent to any desired strake or twist the same as in an ordinary hand-geared machine for bending keel plates.

The machine is supplied with the necessary valves and pipes connecting valves to cylinders; it is made in various sizes to bend keel plates cold from ¾ inch to 1⅛ inches thick, and from 16 feet up to 31 feet 6 inches long. It is manufactured by Hugo Smith & Company, Possil Engine Works, Glasgow.

Monarch Rivet-Heating Furnace.

The Monarch Engineering & Manufacturing Company, Baltimore, Md., have on the market a portable rivet-heating furnace which is especially recommended for ship, bridge, boiler and general construction work. Oil or gas is used as the fuel, and, referring to the illustration, the flame is di-

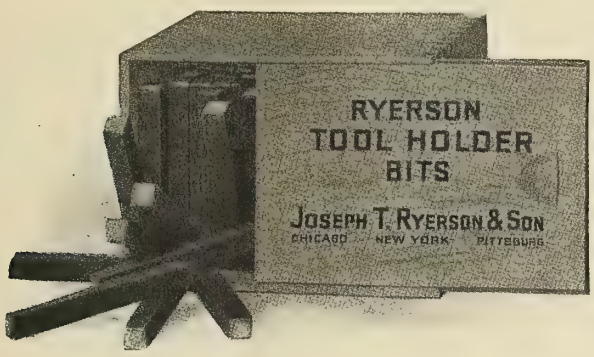


rected into combustion chamber *A*, where the oil is thoroughly ignited. It then passes into the heating chamber *B*, the construction of which gives the flame its rotary motion, distributing the heat uniformly throughout the whole interior. The waste heat escapes through the opening *C*, and distributes itself into the open chamber *D*, where the rivets may be placed prior to their being put into the heating chamber *B*. The fur-

nace is supported on a steel cylindrical sheet, which contains the fuel oil tank *I*, and the whole is mounted on a cast iron base. The furnace top is made of steel, securely welded together, with angles riveted to the bottom, so that the furnace top may be set on to the sheet without being permanently attached to it. It is claimed that the furnace carries a high, soft, uniform heat, and is always under control of the operator, the rivets always being in plain sight and readily reached. The capacity of the furnace is claimed to be 3,000 ¾-inch rivets per day, and from 1½ to 2 gallons of oil are consumed per hour, according to the quantity of rivets heated.

Ryerson Tool Holder Bits.

Joseph T. Ryerson & Son, Chicago, Ill., are now putting on the market Ryerson tool holder bits, which are made of high-speed steel already hardened in tool holder sizes, cut in 3-inch lengths and packed in small boxes. The only work necessary



is to grind to shape. This will meet with great favor among small shops, as it means considerable saving in material and time, and owing to the excellent facilities which the manufacturers have for hardening, best results are obtained from the high-speed tool steel.

An Automatic Low-Pressure Acetylene Gas Buoy.

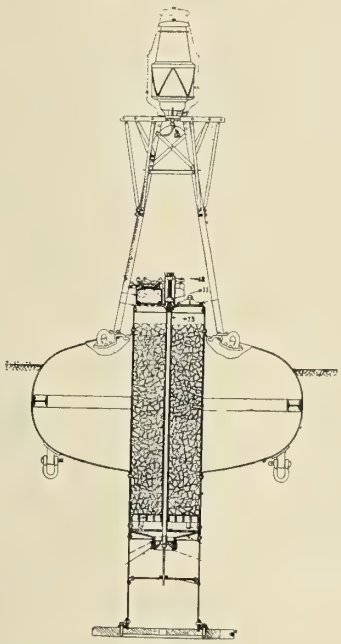
Until recently floating lighted buoys were generally operated by high-pressure oil gas. This gas was generated on shore and compressed to a high-pressure and stored in heavy steel holders. These holders then had to be transported to the buoys and the gas transferred, involving considerable time and expense when it became necessary to recharge the buoys.

Recently a new system of supplying gas for lighted buoys has been developed by the International Marine Signal Company, Ltd., Ottawa, Can. Under this system the lighting medium is low-pressure acetylene gas from which all impurities have been removed by the use of a special purifier. The buoys are charged with from 1,500 to 3,500 pounds of calcium carbide, which, it is claimed, gives a continuous light without diminution of power for from six to nine months, during which time the buoy requires no attention. The lantern used is the best buoy type, equipped with a Fresnel lens, which condenses the light into an intensely powerful and penetrating horizontal beam. This, coupled with the fact that acetylene gives a brilliant penetrating light of high-candle power, makes the light especially valuable for marine work.

These buoys are manufactured in various sizes and shapes to meet special requirements, but the operating parts of all the buoys are practically similar in each case to those shown in the diagram. The buoy consists of a gas generator tube of steel, supported by a steel floating chamber; a lantern support, made of steel, which is attached to the deck of the floating chamber; a lantern; a purifier chamber located at the top of the generator, and the counterweight attached to the bottom of the generator tube to give the buoy the necessary stability.

The generator has a diaphragm a few feet from the bottom of the tube; the center of this diaphragm is fitted with a conically-seated valve mounted on a valve stem, which passes up through the center of the generator and through the generator head. The upper end of this valve stem is fitted with a hexagon nut just above the generator head; the part of the stem passing through the generator head has a keyway cut into it, and a spline is fitted into the generator head engaging the keyway, so that when the nut is turned to close or open the valve the stem cannot turn, it can only move up and down. A stop collar is attached to the extreme top end of the valve stem, with the object of preventing the nut from being turned so far as to drop the valve and valve stem.

To prevent leakage of gas when the buoy is in operation, a cap is screwed down upon the generator head against rubber packing. This cap is long enough to permit the valve stem being raised or lowered, so that the valve may be adjusted to give an opening suitable for the conditions under which the buoy may be working. The valve stem is inclosed within



a guard pipe to protect it from the carbide, and it works through a guide bar, which is bolted to shelf angles at the side of the generator tube. In the center of the diaphragm and surrounding the valve is fitted a grid, which prevents small pieces of carbide which may pass through the grate from falling into the water and wasting their gas. This grid acts as a valve seat and is provided with a rubber packing, which is held in a groove in the seat and projects sufficiently to make a good joint with the valve when it is closed, even if it be foul. A steel grate upon which the carbide rests is attached to the inside of the generator a short distance above the diaphragm.

In operation the generator is filled with calcium carbide in large crystals 8 inches by 4 inches, and the buoy is placed in the water with the valve open and the valve cap screwed down. The water enters the generator through the hole shown in the center of the counterweight at the bottom of the tube, and passes through the valve up to the carbide resting on the grate. The contact of the water with the carbide immediately produces gas, which passes up through the carbide and into the purifier chamber, where all impurities and

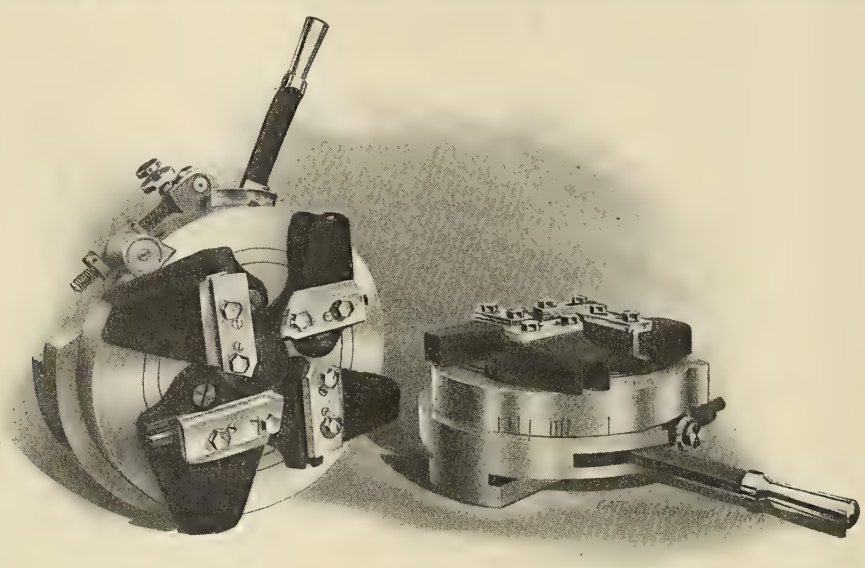
dust are removed; thence it proceeds through a small valve and pipe to the lantern.

When gas is produced faster than it is consumed by the lantern it accumulates in the generator at an increasing pressure, that gradually forces the water away from the carbide, thus stopping generation. As the surplus of gas is consumed by the lantern the gas pressure gradually decreases, thus permitting the water to come in contact with the carbide when generation is resumed. In this manner the buoy is absolutely automatic in operation, and the pressure can never rise above that corresponding to the head of water, due to the denpth of the generator tube below the surface. This pressure is about 6 pounds per square inch. It is practically impossible, therefore, for disastrous explosions to occur such as have frequently taken place where buoys are charged with high-pressure gases or compressed acetylene.

The purifying chamber which cleanses the gas is filled with a special chemical mixture, which it is claimed will absolutely prevent carbonization or clogging of the burners. As has been stated, these buoys will remain in continuous operation from six to nine months, when they can be recharged with calcium carbide, which can readily be purchased in almost any market. The purifying agent, it is claimed, will last about a year.

Stationary Die Head for Pipe Threading.

A stationary die head for pipe threading is being manufactured by the Landis Machine Company, Waynesboro, Pa., in which the Landis type of die is used with a manually-operated die head. This head is made especially for use on pipe-threading machines, wherein the pipe revolves and the head remains stationary, the dies being opened and closed by hand.



The head is made entirely of steel as are also the die holders. The chasers for the heads can be made to good advantage from high-speed steel, as it is claimed that they never require to be annealed, rehobbed or retempered, and that they have the further advantage of long life. The sharpening of the die is a simple operation, and is taken care of by grinding on the ends of the chasers and again setting them to the correct cutting position in the holders by means of a small gage furnished with the die head. The heads are made in standard sizes to take work up to and including 4 inches. One set of dies will cut all the diameters coming within the same pitch. As there is but one pitch covering the sizes from 1 inch to 2 inches, inclusive, one set of dies covers this range. The same is true on the other pitches.

Special holders are made for pipe threading where it is not necessary to cut very close to a shoulder. The clamp with which this chaser is held is what is known as a mill clamp, which besides holding the chaser rigidly protects the chaser in case the pipe splits. The clamp comes down over the throat of the die, and is rounded out near the cutting point, so as to act as a guide for rough ends, and at the same time

when a twister occurs in the pipe the strain is thrown in great part on the clamp, thus protecting the die in such manner that the liability of breakage is very small. In case of threading close to a shoulder a clamp is used which comes flush with the front edge of the chaser only, thus permitting the die to run close up against the shoulder as in threading short nipples, etc. It is claimed that these dies admit of cutting speeds from 25 to 100 percent higher than the hobbed type of die, and that the rake can at all times be ground to suit the quality of the material in the pipe to be threaded.

The heads are graduated for setting the dies to the different diameters to be threaded. The head is opened and closed by hand, and when in the closed position the die is rigidly locked, but opens and closes freely by means of the lever. All dies are made to interchange, and if one chaser of a set should be worn out in advance of the others this single chaser can be replaced without replacing the entire set. Dies of any one pitch will interchange on any of the die heads so long as the pitch is within the range of the head.

The heads are made in standard sizes as follows: From ¼ to 1 inch, inclusive; from ¼ to 1½ inches, inclusive; from ½ to 2 inches, inclusive; from 1 to 4 inches, inclusive.

TECHNICAL PUBLICATIONS.

Hydraulic Elevators. By William Baxter, Jr. Size, 6 by 9 inches. Pages, 326. Figures, 260. New York, 1910: McGraw-Hill Book Company. Price, $2.50 net.

The design, construction, operation, care and management of various types of hydraulic elevators are carefully considered in a practical manner in this book. A large number of diagrams and illustrations serve to give the reader a comprehensive idea of the details of elevator construction and operation. It will be found particularly valuable as a work of reference for the engineer who has not specialized in such work, but who is sometimes confronted with problems requiring accurate knowledge of many of the details.

Manual of Steam Engineering. By W. H. Wakeman. Size, 3 by 5½ inches. Pages, 441. Numerous illustrations. New York, 1910: New York Belting & Packing Company, Ltd.

This book is primarily a reference book, containing data used in every-day engineering practice, arranged in convenient form, with sufficient explanation to render the matter both interesting and instructive. It contains many tables, which are arranged for use in connection with the reading matter on the same subject, thus condensing information into convenient space and rendering it available for busy workers. The author has had considerable experience as a technical writer, and this has enabled him to present the various subjects treated in an exceptionally clear and useful manner. The book is divided into two parts, one of which is confined to steam boilers and the other to steam engines.

Beeson's Marine Directory of the Northwestern Lakes. Size, 6¾ by 9½ inches. Pages, 273. Numerous illustrations. Chicago, 1910: Harvey G. Beeson. Price, $5.

This is the twenty-fourth year of publication of this directory, which is now recognized as a standard authority on commerce and shipping on the Great Lakes. It includes tables of American and Canadian steam and sailing vessels on the Great Lakes, information regarding vessels which have been lost during the previous season, the various transportation and shipping associations, classified lists of vessels according to the trade in which they are engaged, particulars of the engines and boilers of the vessels, as well as interesting articles regarding various Lake ports and miscellaneous marine subjects. The numerous half-tone illustrations are also of considerable interest.

American Producer Gas Practice and Industrial Gas Engineering. By Nisbet Latta. Size, 7½ inches by 10½ inches. Pages, 539. Illustrations, 247. New York, 1910: D. Van Nostrand Company. Price, $6 net.

This is by far the most complete work which has yet appeared on American producer-gas practice. That this branch of engineering has already reached immense proportions will undoubtedly surprise many to whom the subject of producer gas has been placed in the category of new developments. Not only for power apparatus but for a great number of varied industrial purposes has the gas producer now become an essential piece of apparatus. Any handbook, therefore, which attempts to cover the field completely soon reaches large proportions. Undoubtedly this book might have been made more concise; but at the same time the value of the data and careful treatment of each subject make it worth a careful study. The author states in the preface that the book was originally written with the urgent desire to maintain an impartial attitude, and to narrate as accurately as possible, without prejudice or undue influence, the various features of gas engineering at present in vogue in the industrial field. This naturally involves the description of a great many patented systems and pieces of apparatus, and where this has been done the description is placed before the reader, together with the method of operation or other data for the purposes of giving information and drawing comparisons, leaving the reader to draw his own conclusions as to the value of the apparatus.

The early chapters of the book include producer operation; cleaning the gas; works details; producer types; moving gases; solid fuels; physical and chemical properties of gases and gas power. The subject of gas engines is treated briefly and from a general standpoint. The remainder of the book is taken up with a discussion of various industrial gas applications and a discussion of heat, combustion, furnaces, pipes, flues, chimneys, etc. The final chapter contains useful tables for use in gas engineering practice, while in an appendix oil fuel producer gas is briefly considered. As this is a more recent development the amount of data available is, of course, limited. This is a direction, however, in which it is very likely that considerable development will take place in the near future, and, therefore, any data appearing upon the subject from reliable sources is of considerable value and cannot be overlooked.

The Engineering Index Annual for 1909. Size, 6½ by 9¼ inches. Pages, 471. New York and London, 1910: *The Engineering Magazine.* Price, $2.

This book represents a continuation of that originally started by the late Prof. J. B. Johnson in the *Journal* of the Association of Engineering Societies in 1884, and turned over by that association to *The Engineering Magazine* at the close of 1895. Each year it has covered with increasing thoroughness the field of periodical literature in engineering and closely related applied sciences. This volume, which is the fourth since the publication has assumed the annual form, comprises a classified index to all engineering literature during the year. The classified plan of indexing, which has only recently been followed out, serves to combine for each specialist a list of the entire current literature on his subject, and to assemble it in such small space that it may be readily found and completely explored. The value of this work is obvious, and it is sufficient to say that the present volume has been edited with the same care and thoroughness as previous volumes, and that it has been made even more comprehensive.

The Yachting Manual and Marine Motorists' Handbook. Size, 4 by 6½ inches. Pages, 306. Numerous illustrations. London, 1910: Horace Cox. Price, 1s.

This book is a comprehensive compendium of valuable information for yachtsmen and motor boat owners, carefully edited and condensed into a pocket edition. Information is given regarding such subjects as the tides, signals, first aid to the injured, general seamanship, Lloyd's classifications, local sailing directions, a glossary of nautical and technical terms in English and French, tables of weights and measures, foreign currencies, records of interest to yachtsmen, rating rules, charts of the various race courses, as well as a list of the racing fixtures for 1910.

PERSONAL.

A. D. Gillett, for many years a well-known builder of steamboats in the Mississippi Valley, died recently at Lake City, Minn.

Edwin B. Sadtler has been appointed New York representative of the New York Shipbuilding Company, Camden, N. J., with headquarters at 12 Broadway, New York City.

Naval Constructor J. H. Linnard, U. S. N., who has been on duty at the Bureau of Construction and Repair since March, 1901, has applied for and been granted a transfer to the retired list. Naval Constructor Linnard is the senior officer of the Naval Construction Corps in the United States navy. His long and meritorius service has won for him the unqualified approbation of his superior officers, and his retirement from active duty will be greatly regretted by all those with whom he has had official dealings, both in civil and naval circles.

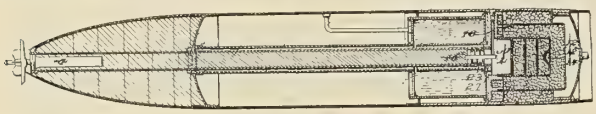
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

956,813. APPARATUS FOR PRODUCING A MOTOR FLUID. HUDSON MAXIM, OF BROOKLYN, N. Y.

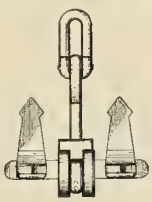
Claim 4.—In an apparatus for producing a motor fluid, the combination of a closed combustion chamber containing a self-combustible material, a spraying or atomizing device leading into said chamber, a



reservoir connected with said device and containing liquid, and a movable wall to said reservoir having a greater area exposed to the products of combustion than is exposed to the liquid in the reservoir. Eighteen claims.

957,830. ANCHOR. JAMES EDGAR WILDE, OF CHESTER, PA.

Claim 1.—In an anchor, a shank having a cross head and provided with a recess at its lower end, a fluke carrying shaft engaging said



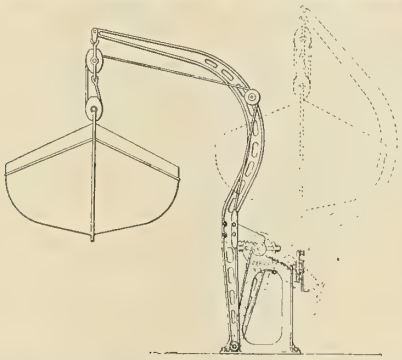
recess, a bearing block seated in the recess, and disks upon the fluke carrying shaft having notches engaging the cross head of the shank. Three claims.

958,650. ATTACHMENT FOR TORPEDO TUBES. JULIUS KIMBRELL, OF NEEDLES, CAL.

Claim 1.—A torpedo tube, a rear door for the same having a locking dial provided with a rack segment, motor-driven means for closing the door, motor-driven means for locking the door, including a pinion engaging the rack segment and a driven shaft with which said pinion is detachably connected, and means for timing the starting of the motors whereby the closing and the locking are effected. Five claims.

958,340. DAVIT FOR HOISTING AND LOWERING BOATS. AXEL WELIN, OF LONDON, ENGLAND, ASSIGNOR TO WELIN DAVIT AND LANE & DE GROOT COMPANY, CONSOLIDATED.

Claim 1.—The combination of a davit pivoted to swing, an arm carried by said davit, a support fixed to the vessel, and an intermediate



member engaging both said support and arm and adapted to travel transversely between the same and relatively to each thereof. Eight claims.

960,129. LIFE PRESERVER. WALTER S. WILKINSON, OF WYTHEVILLE, VA., AND GEORGE B. UPHAM, OF BOSTON, MASS.

Claim 1.—As an article of manufacture, a filler for life preservers comprising blocks composed of granules or small bodies of buoyant material, a waterproof fabric covering therefor, and an outer covering of buoyant material. Seventeen claims.

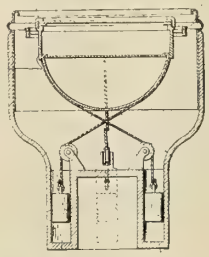
961,285. REVERSIBLE PROPELLER. ELLSWORTH S. BRYANT, OF DETROIT, MICH.

Claim 2.—A reversible-blade propeller mechanism comprising a rotatable main shaft, a solid hub secured thereto having bearing facets in planes parallel to the shaft axis, a propeller blade pivotally secured on each facet to swing obliquely to the shaft, a coupler adapted to swing the blades in unison, a sleeve non-rotatably and longitudinally reciprocable on the shaft and carrying the coupler, a bushing rotatably secured on the sleeve, a standard having a boss in screw-threaded engagement with the bushing, a gear on the bushing, and a lever swinging on the standard transverse to the shaft provided with a rack in mesh with the gear. Five claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

2,277. MAGNETIC COMPASSES. J. C. DOBBIE, GLASGOW.

Claim.—The invention has for its object to cause oscillations of the bowl to be rapidly damped down. In the plane of the knife edges are attached a pair of cords passing over pulleys mounted on the binnacle, the cords carrying weights. A second pair of weights may be pro-



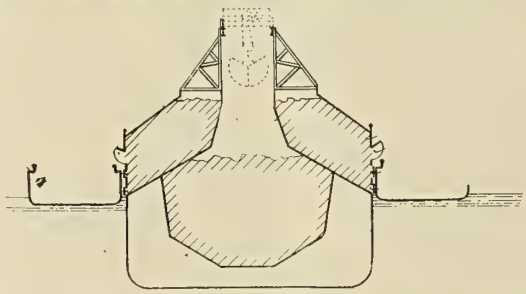
vided at right angles. By the above construction the tendency of the compass bowl to oscillate and give rise to disturbances of the card is greatly diminished by the friction introduced by the cords and pulleys and partly by the inertia of the weights.

3,630. DOCK AND METHOD OF DOCKING SHIPS. N. GROUCHETZKY, ST. PETERSBURG, RUSSIA.

Claim.—In order to accommodate ships of greater depth than heretofore, the keel blocks form a chain which can be drawn from its position below the keel on to the side wall by gearing. The ship can then be floated in and the gate closed. Water is next forced pumped in and the ship then raised so that the keel blocks can be hauled back to their place, then the water is let out in order that the keel may rest upon them.

7,358. SELF-DISCHARGING SHIPS. H. GATJENS, HAMBURG, GERMANY.

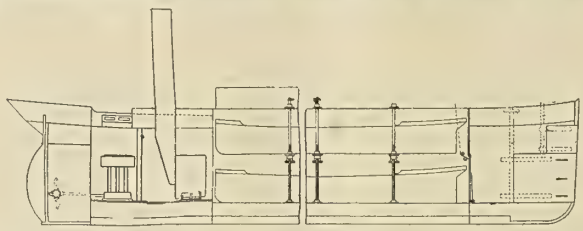
Claim.—By this arrangement the decks are sloping and several apertures or rows of apertures are vertically provided between the separate decks, so that on the ship automatically rising in consequence of the discharge of the cargo, the separate rows of apertures can be brought



successively into use. If the ship is of sufficient beam, the cargo may all be so stowed that it will thus discharge itself. With ships of smaller beam it is advisable to stow most of the cargo between the decks, arranged for self-discharging, and to place the remainder beneath these decks and raise it by grabs or otherwise.

20,756. SHIPS FOR CARRYING SMALLER VESSELS. A. N. DEN OUDEN, BOLNES, HOLLAND.

Relates to vessels adapted to be sunk so as to admit torpedo craft, etc., for raising them. The invention consists in the provision of transverse



bearers adapted to receive a small craft and to be moved upwards, providing sufficient space for another craft beneath. Rotatable doors are arranged externally and adjacent to the ordinary trap doors.

17,289. SHIPS' STEERING GEAR BRAKES. M. DRYSDALE, GRAVESEND.

The brake, in accordance with this invention, comprises a strap passing around a brake drum on the steering wheel, the ends of the strap being connected with a double-action foot lever consisting of two lever members extending in line and connected by toothed sectors so as to move in unison. A rod is connected to one of the lever members, and is furnished at its upper end with ratchet teeth adapted to engage with a front plate so as to hold the brake at any desired tension.

28,439. FITTING SHIFTING BOARDS IN HOLDS, IN WAY OF HATCHWAYS. F. W. BARDENS, LONDON.

According to the invention, a vertical girder is constructed to form two vertical channels on opposite sides. The girder is erected in the center of the hatchway, one of the channels at the fore and the other at the after side. The lower end is secured to shoes at the bottom of the hold. The top is secured to a thwartship beam at the middle of the hatchway coaming. At the fore and after ends of the hatchway vertical channels hold the two separate sections of boards in position.